A Thesis in General Surgery

A CLINICAL STUDY OF SOLITARY NODULE OF THYROID

Submitted in partial fulfillment of the
Requirements for the Degree of
M.S General Surgery
(Branch I)

Kilpauk Medical College

The Tamilnadu Dr. M.G.R Medical University Chennai

APRIL – 2016

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled "**A CLINICAL STUDY OF SOLITARY NODULE OF THYROID"** is a bonafide and genuine research work carried out by me under the guidance of Dr.V.Ramalakshmi, M.S., Professor, Department of General Surgery, Kilpauk Medical College, Chennai. This dissertation is submitted to THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY, CHENNAI in partial fulfillment of the requirements for the degree of M.S. General Surgery examination to be held in April 2016.

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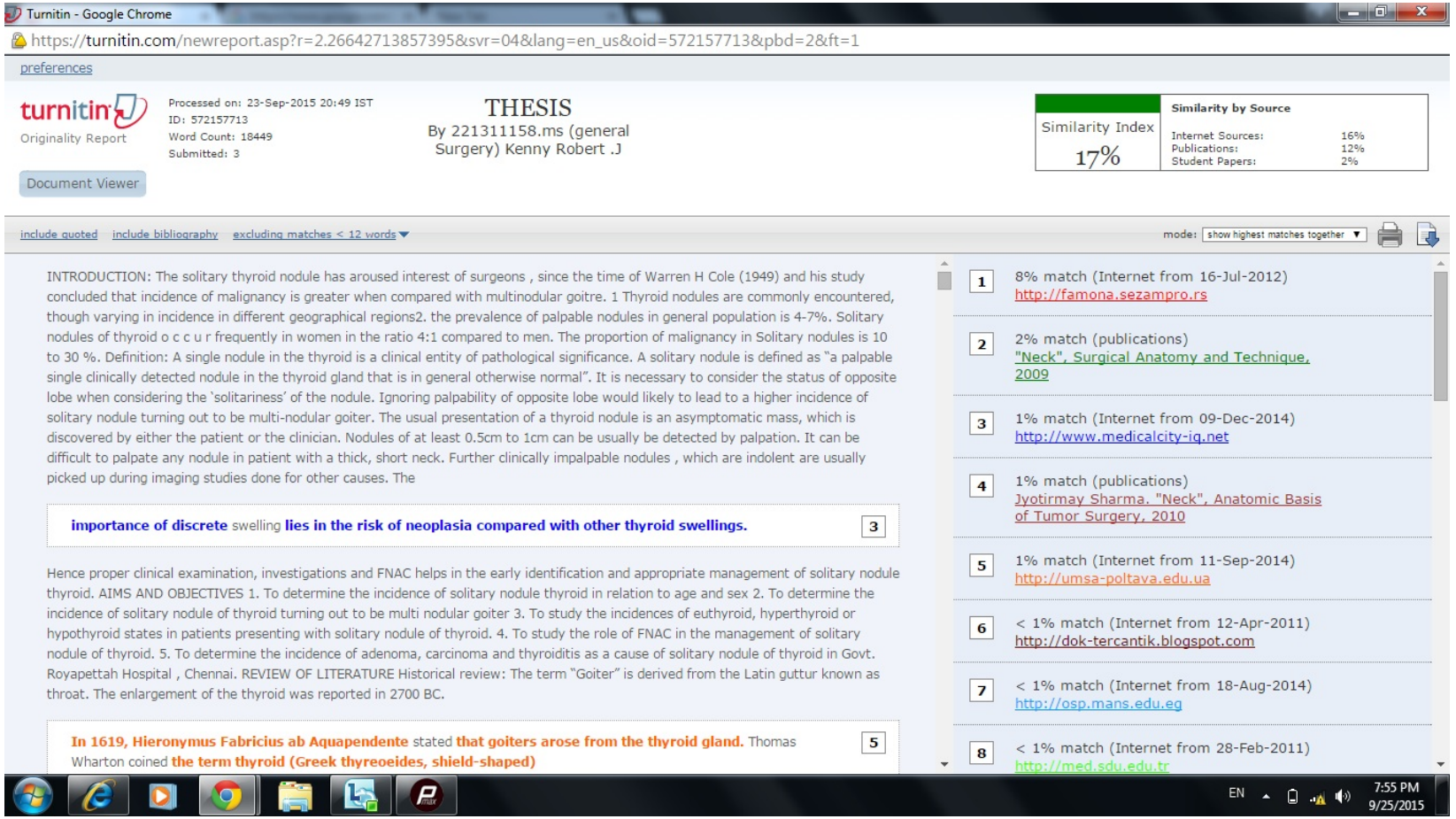
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LIST OF ABBREVATIONS

AG	Adenomatous goiter
ATC	Anaplastic thyroid carcinoma
ECG	Electrocardiogram
FNAC	Fine needle aspiration Cytology
HPE	Histopathological examination
MIT	Monoiodotyrosine
MTC	Medullary thyroid Carcinoma
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T4	Thyroxine
TBG	Thyroxine binding globulin
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USG	Ultrasonography
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ABSTRACT

Background and Objectives:

Solitary nodule of thyroid has increased in incidence in the present day as compared to two decades before. Because of possibility of malignancy, some clinicians especially those in surgical subspecialties recommended that all nodules have to be removed. This study aimed to determine the propotion of solitary nodule of thyroid in general population and in relation to age and sex, the propotion of solitary nodule of thyroid turning out to be multi-nodular goiter, the propotion of euthyroid, hyperthyroid or hypothyroid states in patients presenting with solitary nodule of thyroid, to study the role of FNAC in the management of solitary nodule of thyroid and to determine the incidence of neoplastic and non-neoplastic conditions as a cause of solitary nodule of thyroid in Govt. Royapettah Hospital, Chennai.

Methods:

This prospective study includes 50 patients, presenting in Govt. Royapettah Hospital, Chennai who were clinically diagnosed as solitary nodule of thyroid between November 2014 to September 2015. All patients were admitted and were subjected to thyroid profile, USG and FNAC. All patients were operated appropriately depending on the FNAC report.

Histopathological examination of the operated specimen was done for all the patients. Depending on the histo-pathological report appropriate postoperative therapies were administered to all the patients and all the patients were followed

up appropriately.

Results:

Commonest presentation of solitary thyroid nodule was asymptomatic. The peak incidence of solitary nodule was observed in 3rd to 5th decade, constituting 60% of the cases studied. Females predominated in number over males in occurrence of solitary nodule in ratio of 1:5.25. 33% of all clinically solitary nodule turned out to be multi-nodular goiter. The common causes of solitary nodule was MNG (26%),follicular adenoma (24%),adenomatous goiter(24%). 95% 0f cases presented with euthyroid state. Incidence of malignancy in solitary thyroid nodule was 18%. Male to female ratio in case of malignant nodule was1:5. Incidence of carcinoma in males presenting as solitary nodule was higher (16.67%) compared to that of females (10.20%). The most common cause of malignancy was papillary carcinoma (55%) followed by follicular carcinoma (45%).

Interpretation and Conclusion:

Solitary nodule of thyroid is more common in 3rd to 5th decades. Solitary nodule of thyroid are more common in females. Most of the patients presenting with solitary nodule of thyroid are euthyroid and only a small percentage of patient with toxicity or hypothyroidism . USG can be accurately used to detect patients with multinodulary goiter who clinically present as solitary nodule of thyroid. Common causes of solitary nodule of thyroid are MNG, follicular adenoma and adenomatous goiter. Incidence of malignancy in male patients

presenting with solitary nodule of thyroid is more when compared to female. The most common cause of malignancy in solitary nodule is papillary carcinoma followed by follicular carcinoma.

Key words:

Solitary nodule, malignancy, euthyroid.

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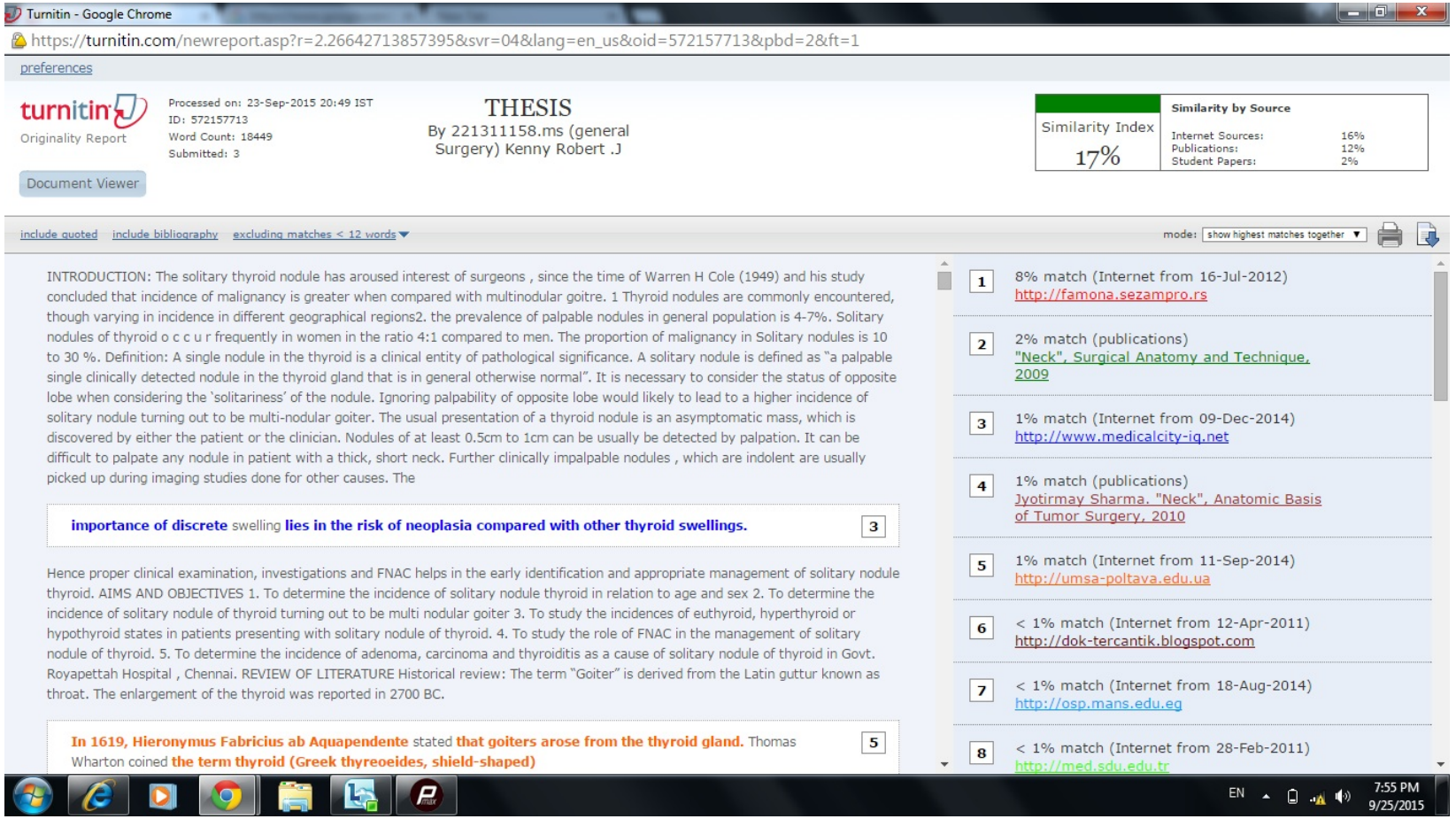
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DEFINITION:

A single nodule in the thyroid is a clinical entity of pathological significance. A solitary nodule is defined as “a palpable single clinically detected nodule in the thyroid gland that is in general otherwise normal”. It is necessary to consider the status of opposite lobe when considering the ‘solitariness’ of the nodule. Ignoring palpability of opposite lobe would likely to lead to a higher incidence of solitary nodule turning out to be multi-nodular goiter.

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impalpable nodules, which are indolent are usually picked up during imaging studies done for other causes.

The importance of discrete swelling lies in the risk of neoplasia compared with other thyroid swellings. Hence proper clinical examination, investigations and FNAC helps in the early identification and appropriate management of solitary nodule thyroid. Favourable prognosis with reduced mortality and morbidity occurs for cases picked up at a earlier stage and for benign lesions.

AIMS AND OBJECTIVES

1. To determine the incidence of solitary nodule thyroid in relation to age and sex.
2. To determine the proportion of solitary nodule of thyroid turning out to be multi nodular goiter.
3. To study the percentage of euthyroid, hyperthyroid or hypothyroid states in patients presenting with solitary nodule of thyroid.
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REVIEW OF LITERATURE

Historical Review:

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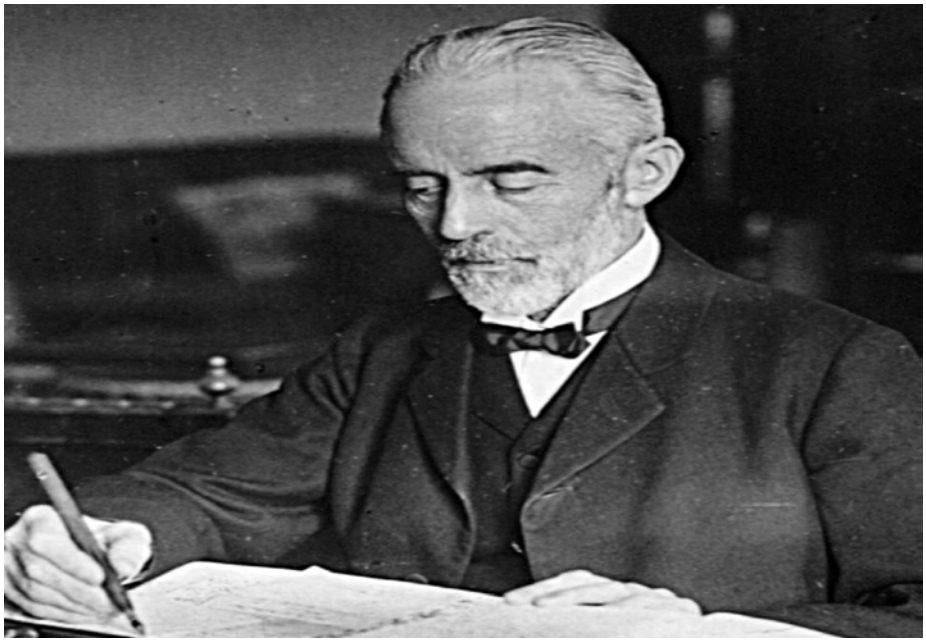
The first documented thyroid surgery for goiters was by Roger Frugardi in 1170. He inserted two setons were inserted at right angles into the goiter, tightening them twice daily until the goiter separated. Caustic powder was used to treat the open wound. Due to the high morbidity and mortality thyroid surgeries were not done until the 19^{th} century, Advances in asepsis, anaesthesia and better understanding of anatomy of thyroid gland increased the number of safe surgeries subsequently. The most notable thyroid surgeons were Emil Theodor Kocher (1841– 1917) and C.A. Theodor Billroth (1829–1894), who performed several surgeries with increasingly successful results. After total thyroidectomy, patients developed myxedema with cretinous features.

Subsequently it was treated by George Murray using a subcutaneous injection of an extract of sheep's thyroid. Edward Fox showed that oral thyroxine also allieviated the symptoms.

In 1909, Kocher was awarded the Nobel Prize for medicine in recognition "for his works on the physiology, pathology, and surgery of the thyroid gland."[9]



Dr. Theodore Kocher – Father of Thyroid Surgery

The Anatomic and Surgical history of the thyroid gland is shown in Table 1[10].

Table 1. Anatomic and Surgical History of the Thyroid Gland

Egypt	2780-2280 B.C.	Statues show signs of Graves' disease
India	2000-1000B.C.	The Hindu *Rig Veda* mentions tracheal cannulation
China	1600B.C.	Used burnt sponge and seaweed to treat goiters
India	400B.C.	The *Ayur Veda* discusses the treatment and diagnosis of goiters
Egypt	69-30 B.C.	A temple wall engraving shows Cleopatra with goiter
Celsus	50-30 B.C.	Described the appearance and surgery of cystic goiters
Galen	(130-200 A.D.)	Considered the thyroid a buffer between the heart and the brain. Called the thyroid cartilage *thyreos,* meaning "oblong shield."
da Vinci (1452-1519)		Provided illustrations of the thyroid glands
Vesalius	1543	Wrote of and illustrated the "Glandes laryngis radici adnatae" (thyroid glands) in *Fabrica*
Fabricius	1620	Thought of a goiter as an enlargement of the thyroid glands
Coindet	1820	Recommended iodine as a treatment for goiter
Graves	1835	Observed and described effects of an overactive thyroid
Owen	1852	Described the parathyroid gland of a rhinoceros
Gull	1873	Described primary myxedema

Sandström	1880	Described the parathyroid glands, suggesting they were embryonic portions of the thyroid
Rehn	1880	Performed a thyroidectomy to treat exophthalmic goiter
Steida	1881	Described thyroid development
Billroth	1881	Reported 48 thyroidectomies performed since 1877, in which only four patients died. First to use artery forceps to prevent and stop hemorrhage. Noted the presence of post-surgical tetany in many
C.MayoErdheim Hals	1906	Studied the relationship between parathyroid glands and calcium metabolism
Crile&C. Mayo	1906	Reported on 132 cases in which he performed a Radical neck excision.
C.MayoErdheim Hals	1907	First to use the term "hyperthyroidism"
Mac Callum and Voegtlin	1908	Studied hypoparathyroidism and its relation to low serum calcium.
C. Jackson &C. Mayo	1909 1912	Performed the first modern tracheostomy Division of Strap muscles for large Goitre
C. Jackson,C. Mayo& Kendall - Schlagenhaufer	1914	Isolated thyroxine
Hanson	1924	Extracted parathyroid hormone
Harington	1926	Determined the chemical structure of thyroxine

EMBRYOLOGY[10]

Normal Development

By the end of the third week, the thyroid gland appears as an epithelial proliferation. It arises as a midline bilobed diverticulum in front of pharyngeal gut. The gland ascends cranial along with the tongue with elongation of the embryo. The thyroid gland and foramen caecum are connected by thyroglossal duct

The thyroglossal duct loses its lumen at 5 weeks. The pyramidal lobe of thyroid is commonly seen. Its due to persistence of caudal end of the thyroglossal duct. The gland is seen developing as two lateral wings with an intervening isthmus. Follicles are seen in second month of intra-uterine life .Colloid occurs in the eleventh week. The neural crest cells of embryo migrate into ultimobranchial body. Ultimo-branchial body gets dispersed into thyroid gland to form the parafollicular C cells of thyroid.

Lingual Thyroid

Aberrant thyroid tissue are found anywhere along the path of descent. Most commonly present at the base of tongue and it's called lingual thyroid. Median analage fails to descent leading to formation of lingual thyroid. The lingual thyroid gland sometimes is the only thyroid tissue present. Radioactive iodine uptake study is essential for diagnosis.

Thyroglossal duct usually gets obliterated. The following are its remnants 1) Pyramidal lobe & 2) thyroglossal cyst Thyroglossal cyst should not be aspirated. After evaluation for presence of normal thyroid tissue, all fragements of duct, cyst and mid portion of hyoid is removed (Sistrunk procedure). Improper removal leads to recurrence

Accessory Ectopic Thyroid Tissue:

These are thyroid tissue outside the pathway of normal descent. The common sites are Mediastinal, Ovarian, Intracheal, Intratracheal, Lateral to jugular, Sella Turcica, Intra-oesophageal etc.

Kocher Billroth

ANATOMY

General Topography:

The thyroid gland consists typically of two lobes, a connecting isthmus, and an ascending pyramidal lobe. In 7 % right lobe is found to be smaller than the left. Complete absence of right lobe is seen in 1.7%. Commonly, in about 50 percent the pyramidal lobe is absent and the isthmus in about 10 percent. A minute epithelial tube or fibrous cord, the thyroglossal duct remnant almost always extends between the thyroid gland and the foramen cecum of the tongue.

The thyroid gland normally extends from the level of the 5th cervical vertebra to the body of the 1st thoracic vertebra. The normal thyroid gland weighs about 10g to 30 g in the adult. Each lobe is approximately 5 cm in length, 3 cm at its greatest width, and 2-3 cm thick.[34] The isthmus connecting the two lobes is about 1.3 cm in breadth. The lobes have a broad lower portion and a relatively conical apex. Capsule of the Thyroid Gland .The thyroid gland is covered by connective tissue capsule (True capsule) which is continuous with the septa, and which makes up the stroma of the organ.

External to the true capsule is a false capsule derived from pretracheal fascia false capsule. It is also called the perithyroid sheath or surgical capsule. Anteriorly and laterally this fascia is well developed; posteriorly it is thin and loose, permitting enlargement of the thyroid gland posteriorly.

There is a thickening of the fascia that fixes the back of each lobe to the cricoid cartilage called the ligaments of Berry.

The superior parathyroid glands normally lie between the true capsule of the thyroid and the fascial false capsule. The inferior parathyroids may be between the true and false capsules, within the thyroid parenchyma, or lying on the outer surface of the fascia

Vascular Supply

The thyroid gland has a great blood supply per gram of tissue.[35] One consequence is that hemostasis is a major problem of thyroid surgery, especially in patients with toxic goiter.

Arteries

Two paired arteries, the superior and inferior thyroid arteries, and an inconstant midline vessel, the thyroid ima artery, supply the thyroid gland

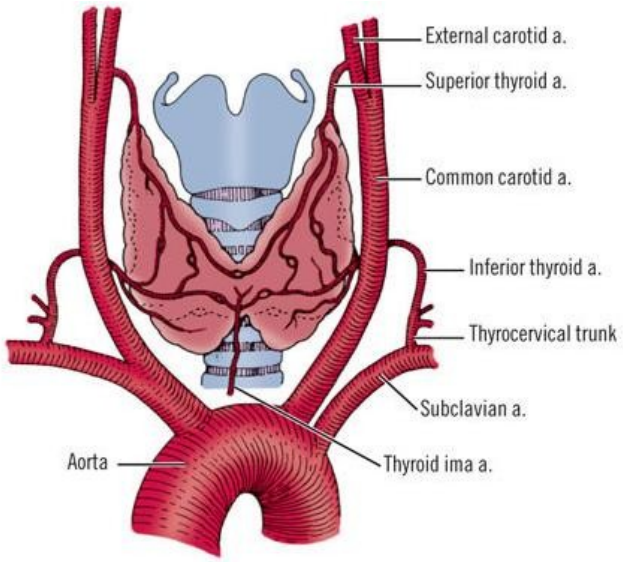


Fig. 3: Arterial Supply of Thyroid Gland

The thyroid ima artery is only occasionally present." (Modified from Tzinas S, Droulias C, Harlaftis N, Akin JT Jr, Gray SW, Skandalakis JE. Vascular patterns of the thyroid gland. Am Surg 1976; 42:639-644;)

Superior Thyroid Artery

The superior thyroid artery arises from the external carotid artery just above, at, or just below the bifurcation of the common carotid artery. It passes downward and anteriorly to reach the superior pole of the thyroid gland. In part of its course, the artery parallels the external branch of the superior laryngeal nerve which supplies the cricothyroid muscle and the cricopharyngeus muscle.

There are six branches of the superior thyroid artery (Fig. 1-56) namely the infrahyoid, sternocleidomastoid, superior laryngeal, cricothyroid, inferior pharyngeal constrictor, and terminal branches of the artery for the blood supply of the thyroid and parathyroid glands. Usually there are two branches to the thyroid the anterior and posterior, but occasionally there may be a third, the so-called lateral branch.

Branches of the superior thyroid artery:

At the superior pole, the superior thyroid artery divides into anterior and posterior branches. The anterior branch anastomoses with the contralateral artery;[36] the posterior branch anastomoses with branches of the inferior thyroid artery. From the posterior branch, a small parathyroid artery passes to the superior parathyroid gland.

Weiglein[38] reported a rare variation of blood supply to the thyroid gland. In this case, the right inferior thyroid artery, was replaced by an artery originating from the right internal thoracic artery. The left inferior thyroid artery was replaced by an artery arising from the vertebral artery.

Inferior Thyroid Artery:

The inferior thyroid artery usually arises from the thyrocervical trunk, but in about 15 percent of individuals it arises directly from the subclavian artery.[39]

The inferior thyroid artery ascends behind the carotid artery and the internal jugular vein, passing medially and posteriorly on the anterior surface of the longus coli muscle. After piercing the prevertebral fascia, the artery divides into two or more branches as it crosses the ascending recurrent laryngeal nerve.

The recurrent laryngeal nerve may pass anterior or posterior to the artery, or between its branches. The lowest branch sends a twig to the inferior parathyroid gland and supplies the lower pole of the thyroid gland. The upper branch supplies the posterior surface of the gland, usually anastomosing with a descending branch of the superior thyroid artery. On the right, the inferior thyroid artery is absent in about 2 percent of individuals. On the left, it is absent in about 5 percent (Hunt et al.).[40]

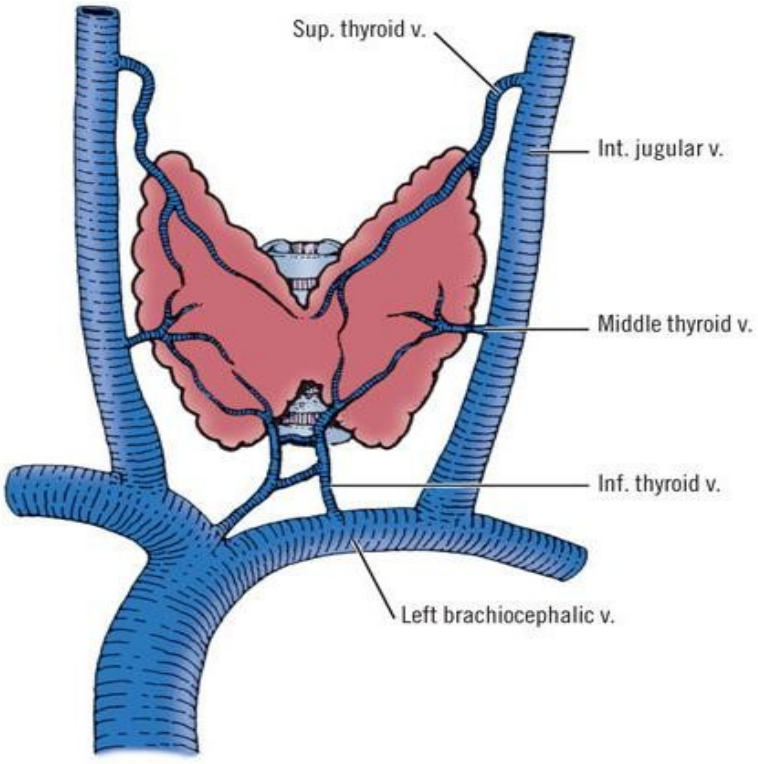
Thyroidea Ima Artery:

The thyroid ima artery is unpaired and inconstant. It arises from the brachiocephalic artery, the right common carotid artery, or the aortic arch. It occurs in about 10 percent of individuals, according to Montgomery.[42] It's position anterior to the trachea makes it important in tracheostomy.

Veins:

Veins of the thyroid gland form a plexus of vessels lying in the substance and on the surface of the gland. The plexus is drained by three pairs of veins, the superior, middle, and inferior thyroid veins.

The Venous Drainage of the thyroid gland.



Superior Thyroid Vein:

It accompanies the superior thyroid artery. As it emerges from the superior pole of the thyroid, the vein passes superiorly and laterally across the omohyoid muscle and the common carotid artery to enter the internal jugular vein alone or with the common facial vein.

Middle Thyroid Vein:

The middle thyroid vein arises on the lateral surface of the gland at about two-thirds of its antero posterior extent. It crosses the common carotid artery to open into the internal jugular vein. The importance of these middle thyroid veins is in their vulnerability during thyroidectomy.

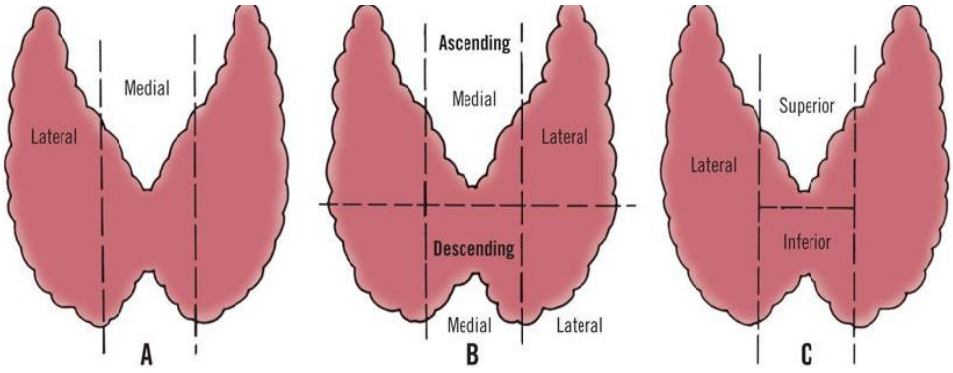
Inferior Thyroid Vein:

The inferior thyroid vein is the largest and most variable of the thyroid veins; the right and left sides are usually asymmetric. The right vein leaves the lower border of the thyroid gland, passes anterior to the brachiocephalic artery, and enters the right brachiocephalic vein. The left vein crosses the trachea to enter the left brachiocephalic vein. Rarely, the right vein crosses the trachea to enter the left brachiocephalic vein, sometimes forming a common trunk with the left vein. This common trunk is called the thyroid ima vein.

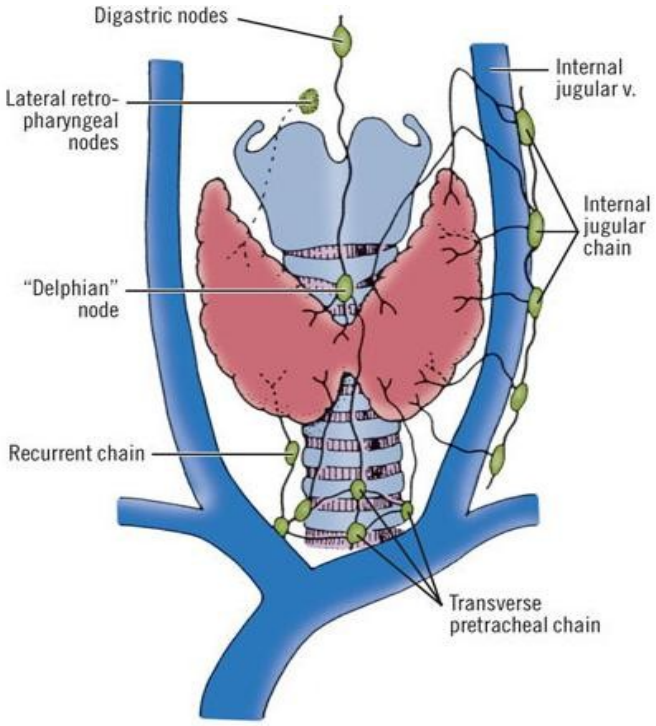
Lymphatics:

Several broad patterns of lymphatic drainage of the thyroid gland have been proposed. Each conceptualization is based on the same facts; each is correct. We will follow that of Hollinshead[43]. The actual drainage is as shown in.

Three concepts of the lymphatic drainage of the thyroid gland



Lymphatic Drainage of the Thyroid Gland



Median Superior Drainage

Three to six vessels arise from the superior margin of the isthmus and from the medial margins of the lateral lobes. These vessels pass in front of the larynx to end in the digastric lymph nodes. Some vessels may enter one or more prelaryngeal ("Delphian") nodes just above the isthmus. Secondary drainage may be to upper jugular nodes on either side or to pretracheal nodes below the thyroid by a vessel passing from the Delphian nodes downward over the front of the thyroid.

It has been suggested that there is a connection between the lymphatic drainage of the superior thyroid artery and the orbit by way of the jugular chain of cervical lymph nodes.[44] In neither the orbit nor the eye itself can lymphatic vessels be demonstrated.[45] The immediate cause of exophthalmus associated with thyroid disease is the enlargement of the extraocular muscles, especially the inferior rectus and inferior oblique. Thyroid antigen or antigen-antibody complexes reaching the eye from the thyroid gland produce an autoimmune response in the extraocular muscles.

Median Inferior Drainage

Several lymph vessels drain the lower part of the isthmus and the lower medial portions of the lateral lobes. They follow the inferior thyroid veins to end in the pretracheal and brachiocephalic nodes.

Right and Left Lateral Drainage

Lymphatic trunks arise from the lateral border of each lobe. Superiorly they pass upward with the superior thyroid artery and vein. Inferiorly they follow the inferior thyroid artery. Between these two groups, some vessels pass laterally, anteriorly, or posteriorly to the carotid sheath to reach the lymph nodes of the internal jugular chain

Posterior Drainage

Posterior lymphatic vessels arise from the inferomedial surfaces of the lateral lobes to drain into nodes along the recurrent laryngeal nerve. Occasionally, a posterior ascending trunk from the upper part of the lobe reaches the retropharyngeal nodes.

Metastatic Spread

A representation of lymph node regions of importance for management of thyroid carcinoma is seen in. Lymph node groups at the highest risk for regional metastasis from differentiated thyroid carcinoma are shown in.

“Lymph node regions of importance for management of thyroid carcinoma”

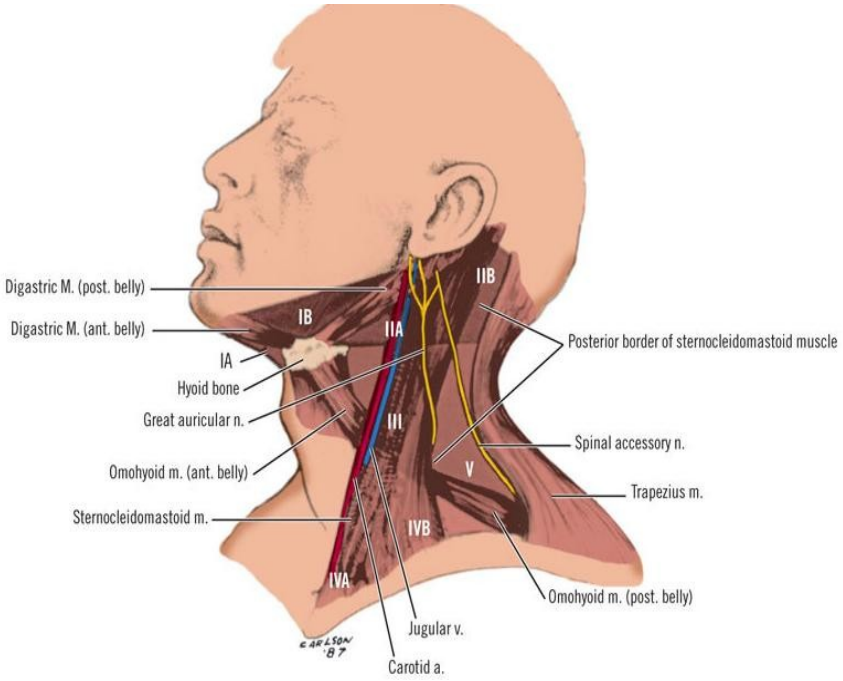
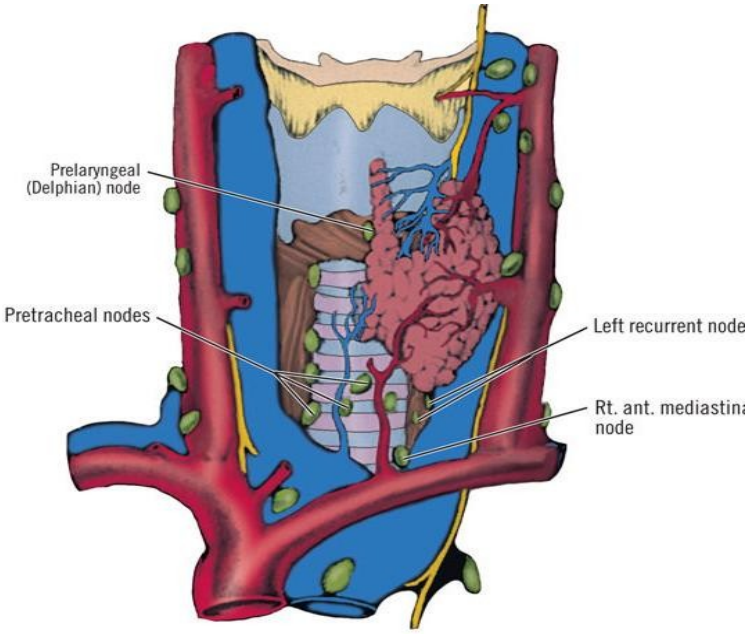


Diagram illustrating lymph node groups at highest risk for regional metastasis



Innervation

The thyroid gland is innervated by the sympathetic system from the superior, middle, and inferior ganglia of the cervical chain. But in thyroid surgery the recurrent and superior laryngeal nerves of the parasympathetic (vagus) system (which play no role in the innervation of the gland) are of utmost importance, so we consider them here.

Recurrent Laryngeal Nerve

Normal Anatomy

The right and left recurrent laryngeal nerves are intimately related to the thyroid gland. The right recurrent nerve branches from the vagus as it crosses anterior to the right subclavian artery. The right recurrent nerve loops around the subclavian artery from posterior to anterior, crosses behind the right common carotid and ascends in or near the tracheoesophageal groove. It passes posterior to the right lobe of the thyroid gland to enter the larynx behind the cricothyroid articulation and the inferior cornu of the thyroid cartilage.

The left recurrent nerve arises, just distal to the origin of the left subclavian artery from the aortic arch. It loops under the ligamentum arteriosum and the aorta, and ascends in the same manner as the right nerve. Both nerves cross the inferior thyroid arteries near the lower border of the middle third of the gland.

Variations

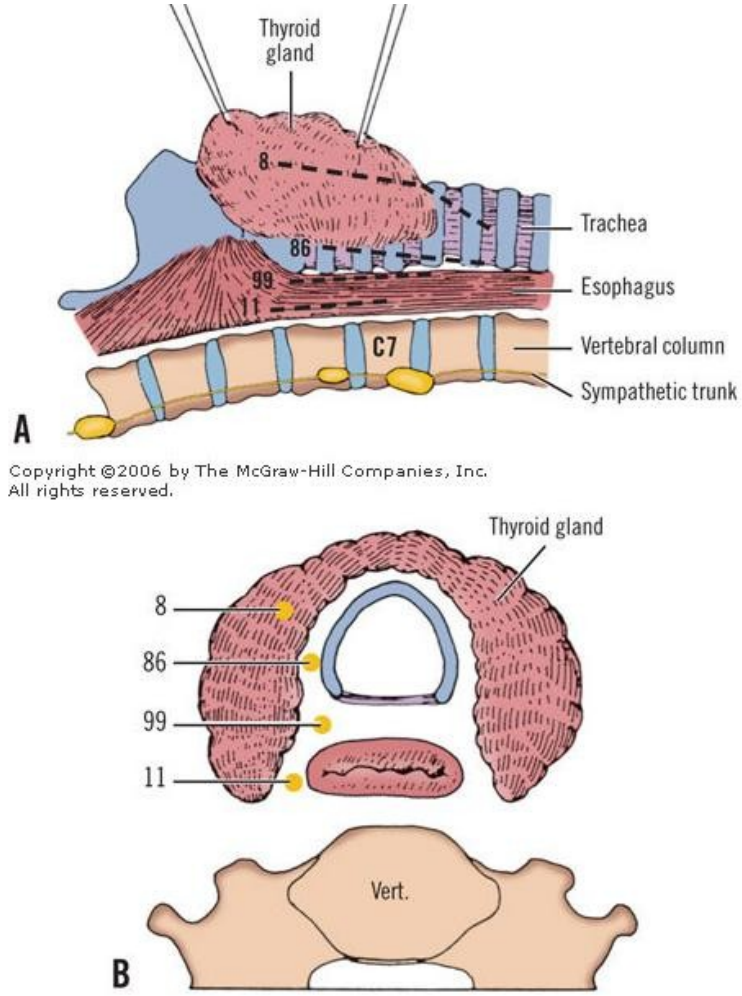
Several variations may occur in the courses of the recurrent nerves. All serve to increase the possibility of injury to the nerve during thyroid surgery. Katz and Nemiroff[47] visualized 1,117 recurrent laryngeal nerves. They reported that 747 (63%) had trifurcation or bifurcation of the nerve away (0.5cm) from cricoid cartilage.

In about 1 percent of patients, the right recurrent nerve arises normally from the vagus, but passes medially almost directly from its origin to the larynx without looping under the subclavian artery. In these cases, the right subclavian artery arises from the descending aorta and passes to the right behind the esophagus. This anomaly is asymptomatic, and the thyroid surgeon will rarely be aware of it prior to operation. Even less common is a nonrecurrent left nerve in the presence of a right aortic arch and a retroesophageal left subclavian artery.

In the lower third of its course, the recurrent laryngeal nerve ascends behind the pretracheal fascia at a slight angle to the tracheoesophageal groove. In the middle third of its course, the nerve may lie in the groove, medial to the suspensory ligament of the thyroid gland (ligament of Berry), within the ligament, or within the substance of the thyroid gland.

A study by Skandalakis et al.[49] revealed that most common nerve lay is in the tracheoesophageal groove next common lie is para-tracheal, other common types are Para-esophageal and rarely intra-glandular nerves.

The course of the recurrent laryngeal nerve at the thyroid gland. About half the nerves were found in the groove between the trachea and the esophagus. **A,** Lateral view. **B,** Cross-sectional view



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In the case of a unilateral single trunk, the nerve passes just behind the cricothyroid joint and can be easily identified. Variations were mainly limited to the level of the extralaryngeal division of the inferior laryngeal nerve. Thus, the surgeon can rely on precise and consistent landmarks in this part of the body, as in other anatomical locations.

The recurrent laryngeal nerve is safest and least visible when it lies in the tracheoesophageal groove. It is most vulnerable when it traverses the thyroid parenchyma. Where it runs in the suspensory ligament of the thyroid, it must be identified and protected before the ligament is divided.

The recurrent laryngeal nerve crosses the inferior thyroid artery at the middle third of the gland. It may lie anterior or posterior to, or between the branches of the artery.[52] Lekacos et al.[53] reported that most recurrent laryngeal nerves (approximately 80%) are located either posterior to or between the branches of the inferior thyroid artery. The three major types of crossings were shown previously in Fig. 1-57A-C. A series by Skandalakis et al.[54] showed that the right nerve most frequently lay between arterial branches (48 percent); the left nerve was usually behind the artery (64 percent). Table 1-6 shows the relative incidence of the types of crossing. No one pattern can be considered "normal"; the surgeon must be prepared for any configuration of artery and nerve Kreyer and Pomaroli[56] reported an anastomosis between the external branch of the superior laryngeal nerve and the recurrent laryngeal nerve. Sturniolo et al.[57] emphasized that the secret to avoiding injury to the recurrent laryngeal nerve during thyroid surgery is as follows: (1) deep knowledge of the surgical anatomy of the thyroid region; (2) total extracapsular thyroidectomy; (3) a thorough search, identification, and exposure of the nerve itself; and (4) following the course of the nerve with care.

Marchesi et al.[59] reported an occurrence rate of 0.34% for a nonrecurrent inferior laryngeal nerve on the right side, and extreme rarity on the left side. They report seven cases of nonrecurrent laryngeal nerve, and emphasize the diagnostic accuracy of angio- MR for the anatomic identification of the vascular anomaly that invariably occurs with the nerve malformation.

The nonrecurrent nerve (left or right, when present) may pass directly to the larynx with no relation to the inferior thyroid artery, or such a nerve may loop around the artery.

Miyauchi et al.[62] reported good results with simple neurorrhaphy or with graft (vagus nerve - ansa cervicalis) of the injured recurrent nerve. Their 8 patients recovered from hoarseness, and maximum phonation improved.

Exposure

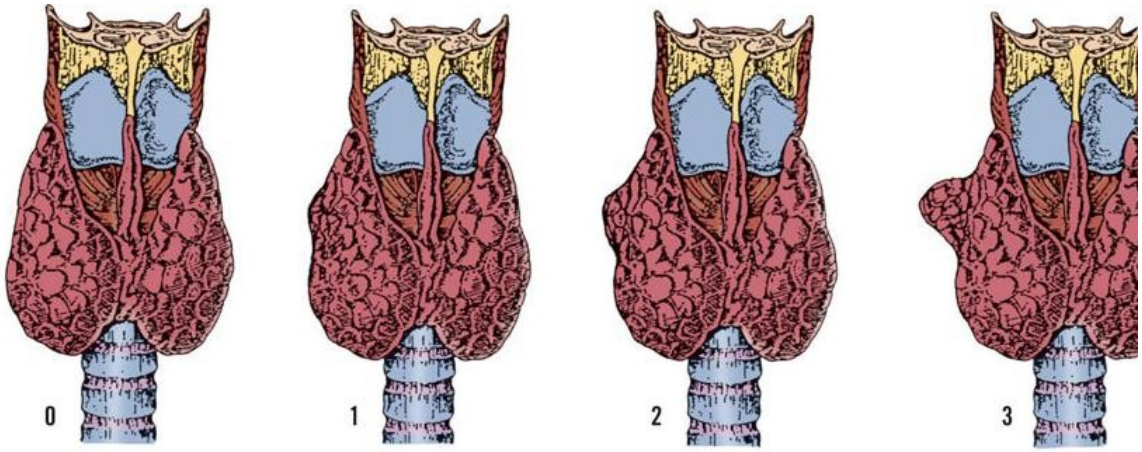
Exposure of the recurrent nerve during any procedure on the thyroid is a sound surgical principle and should be done wherever possible. If the nerve cannot be found readily, the surgeon must avoid the areas in which it may be hidden. Fibrosis, increased bleeding, and lack of clear anatomic relationships are responsible for most nerve injuries. Postoperative exploration for hemorrhage also is associated with a higher risk of nerve injury.[64]

At one time the recurrent nerve was considered so delicate that "if a recurrent laryngeal nerve is seen during thyroidectomy, it is injured."[66] It is now believed that visual identification, with avoidance of traction, compression, or

stripping the connective tissue is most ideal. Complete anatomic dissection is not required, but simple exposure will not destroy it., Jatzko et al.[67] noted a significantly higher rate of injury to the recurrent laryngeal nerve when it was not identified (5.2%) than when it was exposed (1.2%).

The recurrent laryngeal nerve forms the medial border of a triangle bounded superiorly by the inferior thyroid artery and laterally by the common carotid artery. The nerve can be identified where it enters the larynx just posterior to the inferior cornu of the thyroid cartilage.[68] If the nerve is not found, a nonrecurrent nerve should be suspected, especially on the right.

Pelizzo et al.[69] advised identification of Zuckerkandl tuberculum (lateral portion of thyroid lobe) to delineate the nerve.



Zuckerkandl's tuberculum size. 0, unrecognizable; 1, only a thickening of the lateral edges of the thyroid lobe; 2, smaller than 1 cm; 3, larger than 1 cm.

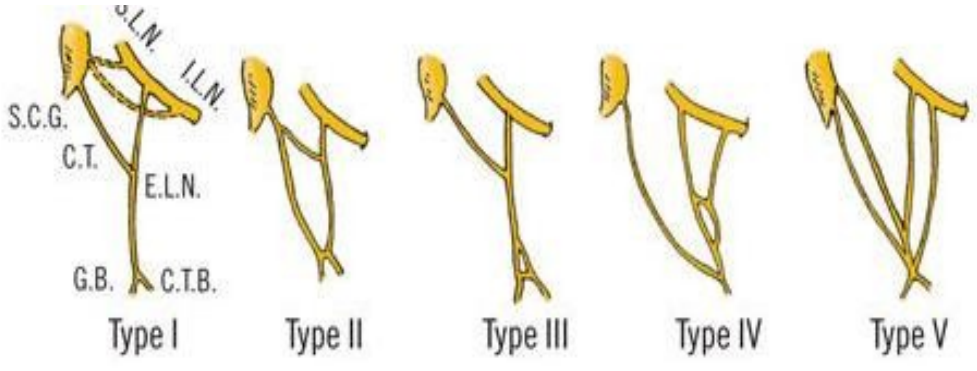
The tubercle of Zuckerkandl is the posterior most extension of the lateral lobes of thyroid gland. It is present at the level of the ligament of Berry[70,71]. In the lower portion of the course of the recurrent laryngeal nerve, the nerve can be

palpated as a tight strand over the tracheal surface. There is more connective tissue between the nerve and the trachea on the right than on the left.

Superior Laryngeal Nerve

The superior laryngeal nerve arises from the vagus nerve just inferior to its lower sensory ganglion just outside the jugular foramen of the skull. The nerve passes inferiorly, medial to the carotid artery. At the level of the superior cornu of the hyoid bone it divides into a large, sensory, internal laryngeal branch and a smaller, motor, external laryngeal branch, serving the cricothyroid muscle[72] and the cricopharyngeus. The point of division is usually within the bifurcation of the common carotid artery.

Sun and Dong[73] dissected 60 adult cadavers (120 superior laryngeal nerves) and reported the morphology and topography of the superior laryngeal nerve, its branches, its anastomoses with the cervical sympathetic, and its relations to the thyroid gland. An anastomotic loop connecting the cervical sympathetic chain and the distal laryngeal nerve was present in 111 of the 120 cases. The morphology of this loop made it possible to define five different types.



Variations of laryngeal nerves. **Type I,** V-shaped in 94 sides (78.3 ± 3.8%). **Type II,** U- shaped in 8 sides (6.7 ± 2.3%). **Type III,** Mixed in 14 sides (11.7 ± 2.9%). **Type IV,** Juxtaposed-double in 1 side (0.8 ± 0.8%). **Type V,** Juxtaposed-triple in 1 side (0.8 ± 0.8%). SLN, superior laryngeal nerve; ILN, internal laryngeal nerve; SCG, superior cervical ganglion; CT, communicating twig; ELN, external branch of laryngeal nerve; CTB, cricothyroid muscle branch; GB, thyroid branch.

To prevent iatrogenic injury of the superior laryngeal nerve during surgical dissection near the thyroid apex in the neck, el-Guindy and Abdel-Aziz[74] recommended anatomical localization of the nerve in the viscerovertebral angle, functional identification, and post- operative analysis.

Internal Laryngeal Nerve

The internal laryngeal branch pierces the thyro-hyoid membrane with the superior laryngeal branch of the superior thyroid artery to enter and supply the larynx. The internal branch is rarely identified by the surgeon; identification occurs only in those cases where a greatly enlarged upper pole of the thyroid gland rises above the superior border of the thyroid cartilage (Fig. 1-70). The internal laryngeal nerve provides general sensory fibers to the larynx and the area of the pyriform recess of the laryngopharynx. It also provides parasympathetic fibers for the glandular elements and some taste fibers that supply taste buds around the epiglottis.

External Laryngeal Nerve:

The external laryngeal branch, together with the superior thyroid vein and artery, passes under the sternothyroid muscles, posterior and medial to the vessels. The nerve then passes beneath the lower border of the thyrohyoid muscle to continue inferiorly to innervate the cricothyroid muscle. In addition to its contribution to phonation, the cricothyroid muscle plays a major role in the overall regulation of breathing by its control of expiratory resistance and flow.[75]

Cernea et al.[77] stated that injury to the external branch of the superior laryngeal nerve will most likely endure, causing a permanent voice change for professional singers. Fatigue, also is common after injury to the external branch of the superior laryngeal nerve. Cernea et al. advised nerve identification in the operating room, especially for patients with large goiters.

In most patients, the blood vessels lie within the visceral compartment of the neck, beneath the pretracheal fascia. The external laryngeal nerve is an exception lies between the fascia and the inferior pharyngeal constrictor muscle. There is thus a plane of dissection between the vessels and the nerve. In about 25 percent of individuals, the nerve lies beneath the fascia together with the vessels.[80]

HISTOLOGY

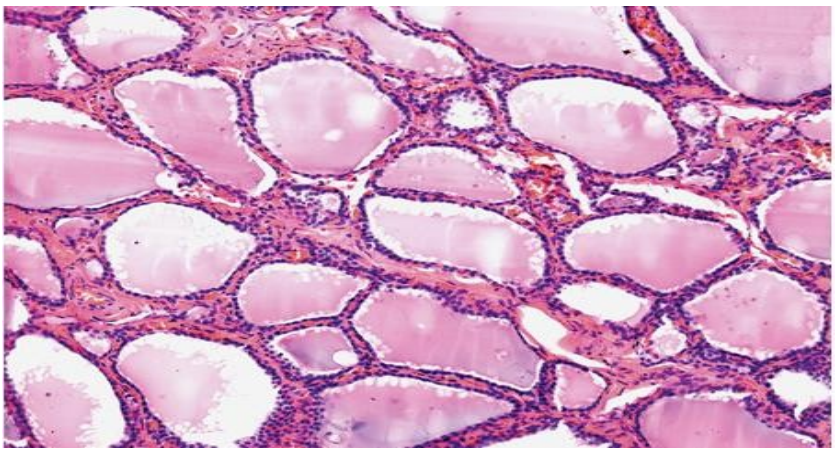
The thyroid gland is surrounded by the thyroid capsule, which is a thin layer of connective tissue. From the capsule, several septa extend within the thyroid parenchyma, dividing it further into several lobules. Epithelial cells either cuboidal or squamous form the thyroid follicles. They are separated by thin connective stroma which is rich in both lymphatic and blood vessels. Small bundles of nerves are present.

There is a colloidal gelatinous collection in the center of the follicle. Each follicle has two types of cells: follicular and parafollicular, or C cells.

According to Ross and Reith, the follicular cells are responsible for the following actions: 1) synthesis of thyroglobulin 2) iodination 3) storage of thyroglobulin, 4) resorption of thyroglobulin, 5) hydrolysis of thyroglobulin, and 6)release of thyroid hormone into the blood and lymphatics.

The parafollicular cells or C cells, can be found in the connective stroma between the follicles or in the follicular epithelium. Characteristically, they contain several secretory granules.

Histology of Thyroid Gland



PHYSIOLOGY

The thyroid gland weighs 10 to 20 g in normal adults and is responsible for the production of two families of metabolic hormones, the thyroid hormones, thyroxine (T4) and triiodothyronine (T3), and the calcium-regulating hormone, calcitonin. The spherical thyroid follicular unit is the important site of thyroid hormone production. The follicular unit is made up of a single layer of cuboidal follicular cells that encompass a central depository of colloid filled mostly with thyroglobulin (Tg). Thyroglobulin is the protein in which T4 and T3 are synthesized and stored.

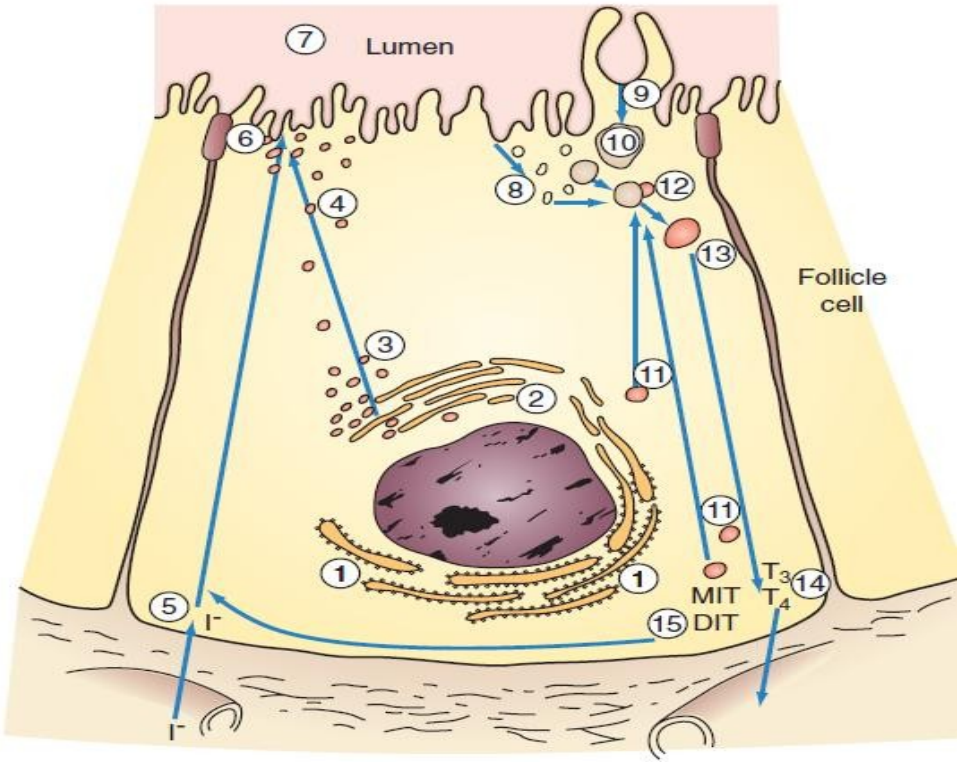
Iodine Metabolism

Iodine is essential for the production of thyroid hormones. It can be efficiently absorbed from the gastrointestinal (GI) tract, in the form of inorganic iodide and rapidly enters its extracellular iodide pool. The thyroid gland is responsible for storing 90% of total body iodide at any given time, with less than 10% existing in the extracellular pool. Iodide is stored in the thyroid as preformed thyroid hormone or as an iodinated amino acid. Iodide is transported from the extracellular space into the follicular cells against a chemical and electrical gradient via an intrinsic transmembrane protein located in the basolateral membrane of the thyroid follicular cells. Once inside the cells, iodide rapidly diffuses to the apical surface, where it is quickly moved to exocytic vesicles. Here, it is rapidly oxidized and bound to Tg. Transport of iodide into follicular cells is regulated by thyroid- stimulating hormone (TSH) from the pituitary gland, as well

as by the follicular content of iodide. The relationship between iodine ingestion and thyroid disease has been known for more than 100 years. At the turn of the 20th century, the practice of iodine supplementation of food and water came about as a result of careful study in areas in which iodine insufficiency was found and linked to endemic goiter. Significant iodine deficiency still occurs in various undeveloped parts of the world. In situations in which iodine excess occurs, disorders such as Graves' disease and Hashimoto's thyroiditis can occur.

Thyroid Hormone Synthesis

Once organic iodide is efficiently oxidized and bound, it couples to Tg with tyrosine moieties to form iodotyrosines in a single conformation (monoiodotyrosine [MIT]) or a coupled conformation (diiodotyrosine [DIT];). The formation of DIT and MIT is dependent on an important intracellular catalytic agent, thyroid peroxidase. This enzyme, along with TG is remarkably specific to the thyroid follicular cells, making both important in the diagnosis and management of autoimmune thyroid disease and well differentiated thyroid cancer. MIT and DIT are biologically inert. Coupling of these two residues gives rise to the two biologically active thyroid hormones, T4 and T3. T4 is formed by the coupling of two molecules of DIT, whereas T3 is formed by the coupling of one molecule of MIT with one molecule of DIT. In normal circumstances, formation of T4 predominates. Both T3 and T4 are bound to Tg and stored in the colloid in the center of the follicular unit.



Diagrammatic scheme of thyroid hormone formation and secretion. 1, Tg and protein synthesis in the rough endoplasmic reticulum. 2, Coupling of the Tg carbohydrate units in the smooth endoplasmic reticulum and Golgi apparatus. 3, Formation of exocytotic vesicles. 4, Transport of exocytotic vesicles with noniodinated Tg to the apical surface of the follicle cell and into the follicular lumen. 5, I odide transport at the basal cell membrane. 6, Iodide oxidation, Tg iodination, and coupling of iodotyrosyl to iodothyronyl residues. 7, Storage of iodinated Tg in the follicular lumen.8, Endocytosis by micropinocytosis.9, Endocytosis by macropinocytosis (pseudopods).10, Colloid droplets.11, Lysosome migrating to the apical pole. 12, Fusion of lysosomes with colloid droplets. 13, Phagolysosomes with Tg hydrolysis. 14, T3 and T4 secretion.15, MIT and DI T deiodination.

Most thyroid hormone released from the thyroid gland is T4, which is deiodinated in peripheral extrathyroidal tissues and converted to T3. Release of T4 and T3 is regulated by the apical membrane of the follicular cell via lysosomal hydrolysis of the colloid that contains the Tg-bound hormones. The apical membrane of the thyroid cell forms multiple pseudopodia and incorporates Tg into small vesicles, which are then brought into the cell apparatus. Within the vesicles, lysosomal hydrolysis results in the reduction of the disulfide bonds and T3 and T4 are then free to pass through the basement membrane and be absorbed into the circulation, where more than 99% of each hormone is bound to serum proteins. Although sensitive assays of peripheral blood can measure Tg, peripheral Tg represents an extremely small fraction of total body stores. Residual iodotyrosines undergo peripheral breakdown, deiodination, and recycling and can then be added to the recently absorbed iodide stores and become available for the synthesis of new thyroid hormone.

Thyroglobulin

Tg is a 660-kDa glycoprotein specific to the follicular cell that is the primary component of the colloid matrix necessary for iodination and hormonogenesis. Tg facilitates the conversion of MIT and DIT into T3 and T4. This process is accompanied by the escape of small amounts of Tg into the peripheral bloodstream, where it can be assayed. TSH enhances the whole process of endocytosis, proteolysis, and release through an adenylate cyclase system. Excess peripheral levels of iodine inhibit further release by enhancing Tg

resistance to proteolysis. Peripheral Tg can be measured to evaluate benign or malignant thyroid neoplasms. Measurement of peripheral Tg has predictive value for the recurrence of well-differentiated thyroid carcinoma, locally or in metastatic deposits after initial total thyroidectomy

Calcitonin

Calcitonin is a 32–amino acid polypeptide secreted by the parafollicular cells, or C cells, located superolaterally in each thyroid lobe. Calcitonin acts principally, to inhibit calcium absorption by osteoclasts and thereby to lower peripheral serum calcium levels. Increased peripheral levels of serum calcium stimulate calcitonin secretion. Calcitonin secretion can be stimulated clinically by the infusion of calcium, pentagastrin, and alcohol. The specific action of calcitonin takes place on the surface receptors of osteoclasts but its effect does not result in a clinically apparent marked decrease in calcium levels. Basal or stimulated calcitonin levels are sensitive markers for primary or recurrent MTC.

Regulation of Thyroid Hormone Secretion

The hypothalamic-pituitary-thyroid axis regulates thyroid hormone production and release in a classic endocrine feedback system. The major regulator of thyroid gland activity is the glycoprotein TSH, which is a major growth factor for the thyroid. TSH stimulates thyroid cell growth and differentiation, as well as iodine uptake and organification and release of T3 and T4 from Tg. Also, TSH has been shown to stimulate the growth and invasive characteristics of some well-differentiated thyroid cancer cell lines in vitro. TSH is a 28-kDa glycoprotein

secreted in a pulsatile fashion by the anterior pituitary gland. It has two components; the α subunit is common to other anterior pituitary hormones but the β subunit is unique to TSH and determines the hormone's biologic specificity. The receptors that respond to TSH have been identified and cloned. Specific mutations in the genetics of this system have been identified and are associated with follicular thyroid neoplasms.

The feedback loop is an important regulator of TSH secretion. Increased thyrotropin-releasing hormone (TRH) from the paraventricular nucleus of the hypothalamus and reduced levels of T3 stimulate release of TSH from the anterior pituitary. Peripheral thyroid hormone levels may, in addition to stimulating release of TSH from the anterior pituitary, enhance TRH secretion. Peripheral T4 is locally deiodinated in the pituitary and converted to T3, which then directly inhibits the release and synthesis of TSH. The condition that usually decreases TSH secretion is classified as primary hyperthyroidism. It has many causes, including many types of thyroiditis, Graves' disease, autonomously functioning thyroid nodules, and conditions that increase human chorionic gonadotrophin (hCG) levels, such as gynecologic malignancies and overuse of exogenous thyroid hormone.

Decreased levels of TSH can also be caused by abnormalities at the level of the pituitary and/or hypothalamus, which are collectively termed *central hypothyroidism.* These conditions are much rarer than primary hyperthyroidism.

Although TSH is the primary regulator of thyroid hormone synthesis, intrinsic autoregulatory mechanisms are alternative routes whereby the thyroid can control intraglandular stores of thyroid hormones. In areas in which dietary iodide is excessive, the thyroid gland has an autoregulated process that inhibits the uptake of iodide into follicular cells. The reverse is true in iodide deficiency. Excessively large doses of iodide have complex effects. These include an increase in organification followed by cessation of production, a syndrome known as the Wolff- Chaikoff effect.

Peripheral Action of Thyroid Hormones

In the periphery, T3 is significantly more potent than T4. Most T4 is converted to T3, which has a high affinity for the peripheral nuclear thyroid hormone receptor (TR), a member of the steroid hormone receptor family. Therefore, the action of thyroid hormones in the periphery consists predominantly of the interaction of T3 with the nuclear TR, which then binds to regulatory regions in various gene-regulated processes. Two genes regulate TR production and activity, the α and β forms, which are located on chromosomes 17 and 3 . The β form of TR is contained within the liver; the central nervous system contains predominantly an α form of TR. The clinical result of thyroid hormone action is regulated through TR and its effect on various genes, expressions of which are then regulated in the nucleus via the production of polypeptides. For example, T3 acts on the pituitary by regulating transcription of the genes for the α and β subunits of TSH, which results in TSH secretion. T3 affects cardiac contractility

by regulating the transcription of myosin heavy chain production in cardiac muscle. Of circulating T3 and T4, 80% is bound to thyroxinebinding globulin (TBG) in the periphery. A number of medications and clinical scenarios alter serum levels of TBG or the affinity of TBG for circulating thyroid hormone.

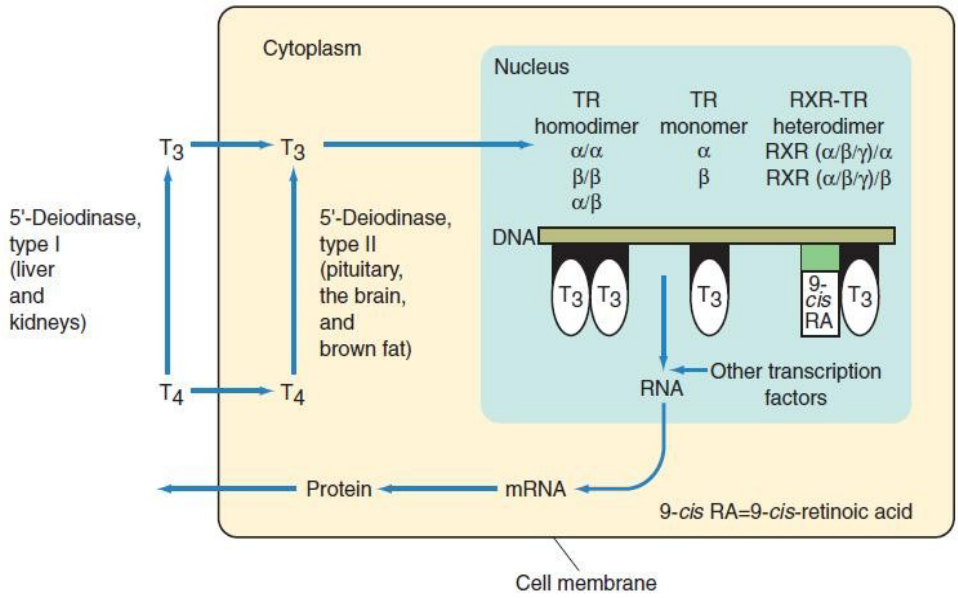


Fig-15. Cellular and molecular events involved in thyroid hormone function

Also, T4 is bound to prealbumin and albumin. In pregnancy and other clinical situations with elevated estrogen levels, such as oral contraceptives, menopausal estrogen replacement therapy, and tamoxifen or raloxifene use (selective estrogen receptor modulators), TBG levels are significantly increased, thereby resulting in higher levels of bound T4 (total) in the periphery. Other causes of increased TBG concentrations include heroine or methadone use, clofibrate, and 5-flurouracil (chemotherapeutic agent). In contrast, decreased TBG levels are caused by agents such as anabolic steroids (testosterone), nicotinic acid, and corticosteroids.

Such states are clinically euthyroid, however, because free T4 levels are not altered. Most T3 and T4 are bound to the extent that free T4 constitutes less than 1% of peripheral hormone. The bound form of thyroid hormone cannot pass from the extracellular space and must be in the free form to diffuse into extracellular tissues to affect major metabolic activity. T3 is especially important in this regard. Most T3 is peripherally derived from the deiodination of T4, which takes place largely in the plasma and liver. Other deiodination processes are found in the central nervous system, especially the pituitary gland and brain tissues, as well as in brown adipose tissue. Peripheral conversion of T4 to T3 can be impaired in many clinical circumstances, such as overwhelming sepsis and malnutrition, thionamide (propylthiouracil) use, high- dose corticosteroids, beta blockers, iodinated contrast agents, and amiodarone use. The half-life of T3 is approximately 8 to 12 hours and free levels disappear rapidly from the peripheral circulation. In adults, the half-life of T4 is approximately 7 days because of the efficient and significant degree of binding to carrier proteins.

Inhibition of Thyroid Synthesis

Drugs Antithyroid medications are an option for the treatment of thyroid excess states. The thionamide class of antithyroid drugs includes propylthiouracil (PTU) and methimazole. This class of drugs acts by inhibiting the organification and oxidation of inorganic iodine, as well as by inhibiting linkage of the initial iodotyrosine molecules MIT and DIT. In addition to these effects, PTU inhibits the

peripheral conversion of T4 to T3.Because of this added capability, PTU is a popular choice for the rapid treatment of hyperthyroid conditions.

Methimazole has longer activity and requires a single daily dose; it is the preferred agent in nonpregnant individuals. Both drugs can cause agranulocytosis but this occurs in less than 1% of cases. Other side effects include rash, arthralgias, neuritis, and liver dysfunction (potentially worse with PTU). Exogenous glucocorticoids can effectively suppress the pituitary-thyroid axis. Also, they can act in the periphery to inhibit the peripheral conversion of T4 to T3. This effectively lowers serum T3 levels, thus allowing steroids to be used as a rapid inhibitory agent for hyperthyroid conditions. Steroids can also lower serum TSH concentration. The rapid action of steroids makes them a potentially important primary treatment of severe, previously untreated, or resistant hyperthyroidism; however, they are not without potential side effects.

Patients with thyrotoxicosis have increased adrenergic stimulation. Although beta blockers do not directly inhibit thyroid hormone synthesis per se, they are valuable in controlling peripheral sensitivity to catecholamines by blocking their effects. Iodine, given in large doses after the administration of an antithyroid medication, can inhibit thyroid hormone release by altering the organic binding process (Wolff- Chaikoff effect). This stunning effect is transient, but iodine supplementation can be used to treat hyperactivity of the gland in preparation for surgery.

EPIDEMIOLOGY AND INCIDENCE

Disorders of thyroid including the 'Solitary nodule' occur worldwide, their incidence varying from high in Switzerland, the Andes and India to low population and the intensity and duration of goitrogenic stimuli to which population is subjected. palpable thyroid nodule in Euthyroid individual is common in clinical practice occurring upto 4% of general population, their incidence increase with age.

In contrast, however, a true solitary thyroid nodule, accounting for up to approximately 25% of clinically detectable solitary thyroid nodule is important both clinically and pathologically since although most of the case turn out be benign, 10-30% will harbour malignant neoplasm . The incidence of malignancy in solitary nodule who undergo surgery is increasing chiefly due to improved selection of patients for surgery.

SEX INCIDENCE:

Thyroid disorders are preponderantly confined to females in the ratio of 6:1 and this is due to variations of thyroid hormone demand during female reproductive function, physiological events such as puberty, pregnancy, lactation. Incidence of solitary nodules is also higher in females. Bhansali[84] has reported F:M ratio of 7:2 and Kapur[85] 2:1 But incidence of Malignancy in solitary nodule is more in men (26%) compared to female (9%).

AGE INCIDENCE:

Thyroid nodules occur at all ages, the reported age range from 15-69 years with maximum incidence in 30-40 years. Solitary nodule is rare in children, the incidence of carcinoma in such a nodule under 25 years of age is about 50% and 75% in patient under 15 years.

INCIDENCE OF MALIGNANCY IN SOLITARY NODULE OF THYROID

Though commonest cause of solitary nodule is not carcinoma, a significant proportion is carcinomatous. In general between 10-20% of solitary nodule removed surgically is malignant.

Solitary nodule found in thyroid of patient less than 20 years and greater than 60 years carries far greater risk of being malignant.

CAUSES OF SOLITARY THYRIOD NODULES

I. Colloid (Adenomatiod) Nodule
II. Thyroid
    adenoma
    Follicular
    adenoma
    Hurtle
    adenoma
    Papillary
    adenoma
III. Thyroid cancer
IV. Primary
    I. Papillary carcinoma

II. Follicular carcinoma

III. Hurtle cell carcinoma

IV. Medullary carcinoma

V. Anaplastic carcinoma

A. Metastatic /Direct invasion

A. Renal cell carcinoma

B. Gastric carcinoma

C. Breast carcinoma

D. Pancreatic carcinoma.

E. Lung carcinoma

F. Head and neck tumors

G. Melanoma

H. Hodgkin's disease

I. Colon carcinoma

- Thyroid cyst
- Thyroiditis
    - Acute
    - Sub acute or De Quervan's thyroiditis
    - Hashimoto's
    - Riedel's thyroiditis
- Infections
    - Abscess
    - Tuberculosis
- Inflammatory
    - Sarcoidosis
    - Amyloidosis

- Developmental abnormalities
    - Thyroid hemiagenesis
    - Teratoma

DIFFERENTIAL DIAGNOSIS OF SOLITARY NODULE OF THYROID

- Thyroglossal duct cyst
- Lipomas
- Extrathyroidal haematoma
- Oesophageal diverticulum
- Parathyroid adenoma, cyst or carcinoma
- Pre and paratracheal lymphnodes.

Solitary nodule of thyroid can arise from diverse causes. The common causes of solitary thyroid nodules are adenomatous goiter, neoplasms and chronic thyroiditis. In practice, a clinical diagnosis of solitary thyroid nodule is, in fact, a dominant nodule of multinodular goiter is 50% of cases, as shown on subsequent investigations any dominant nodule within a multinodular goiter should be essentially treated as solitary thyroid nodule, as they have incidence of malignancy of around 10%.

ETIOLOGICAL FACTORS

➢ Etiology of adenomatous nodules

Adenomatous goiter occur as a result of compensatory mechanism against deficient synthesis of thyroid hormone by the thyroid gland. The hormone by the thyroid follicles is regulated by TSH, secreted by anterior pituitary which in turn is regulated by negative feedback mechanism by the levels of thyroid hormone in blood and by TRH sercreted by hypothalamus. When there are low levels of T3 and T4 in blood they stimulate anterior pituitary to secrete TSH , which acts on follicular cell, induces hyperplasia, and hypertrophy to trap iodine and synthesis more of T3 andT4 . The hyperplasia may not occur uniformly, several foci of hyperplasia may result, of which some are large, some small. Following hyperplasia there is involution after need for T3and T4 decrease. Repeated stimulation of thyroid causes hyperplasia and involution of varying degrees end also degenerative changes and fibrosis resulting in nodularity. If among various nodule only one of them attain large size which cannot be detected clinically, a solitary adenomatous nodule ensues.

Iodine deficiency in endemic area results in endemic area results in highest incidence of goiter and greater than 50% prevalence is found in extreme iodine deficient area.

➢ ETIOLOGY OF THYROID NEOPLASMS:

a) Radiation: The relationship between ionizing radiation and development of benign adenomas and malignant tumors is well known. Thyroid exposure to radiation can occur in two ways. External and Internal Sources. External exposure can be because of medically administered external beam radiation or environmental exposure previously related to nuclear weapons attack or weapons testing and more recently nuclear power plant accidents.

Internal ingestion of isotopes of iodine which is concentrated in the thyroid gland can come from the fallout from nuclear weapons, or from ingestion of the isotopes from the fallout from nuclear weapons, explosion or power plant accidents .

The carcinogenic radiation is by 2 mechanisms

1. Cellular injury with altered cell division and replication of nucleic acids.
2. The injured cells produce less thyroid hormone leading to TSH stimulation which is itself radiation exposure include:
    a) Amount of radiation received
    b) Duration of radiation received
    c) Age at which radiation was received
    d) Latent period

Low dose radiation for Tinea capitis (6-5 cGy), thymic enlargement (100 to400 cGy), enlarged tonsils and adenoids (750Egy) Acne vulgaris (200 to 1500

cGy) are best known etiological factor . The risk increases linearly from 6.5 to 2000 cGy, beyond which the incidence decline as radiation causes destruction of thyroid tissues. The risk maximum 20 to 30 years after exposure. Approximately 30% of exposed children develop thyroid nodules and of these estimated 30% are malignant

b) Ingestion of radioisotopes and malignancy

The most common exposure is due ^{131}I administered for diagnostic thyroid scans. A typical scan exposes the thyroid to approximately 50 rads of external beam radiation. Studies have shown that is only a small increase in the of incidence of malignancies of thyroid after exposure to this dose.

A more dangerous type of ingestion of radioisotopes comes from exposure to nuclear fallout. Contrary to medically administered ^{131}I and short lived radio - isotopes such as ^{129}I and $^{131\text{-}135}$ I.

Vast majority of patients developing post radiation malignancy have papillary histology.

c) Diet

There is an increased incidence of follicular cancer in iodine deficient endemic goiterous areas as well as an papillary carcinoma in iodine rich regions.

d) Sex:

Factors such as parity, early menopause, contraceptive use and late age at first birth in female population have been reported to have increased risk of

thyroid carcinoma but the data been inconsistent.

The thyroid nodule is more likely to be a cancer in men than in men than in women and in young (under 20 years) and older (over 60 years) patients rather than others.

e) Genetic predisposition:

There is no clear familial syndrome or genetic dis ease associated with non-medullary thyroid carcinoma. Loose associations with familial polyposis of colon including Gardner's syndrome, Cowden's syndrome, melanomas, testicular and bladder cancer have been reported. This contrasts with medullary thyroid carcinoma, which has a variety of genetic syndromes now being defined at molecular levels. The familial medullary carcinoma syndromes is transmitted as an autosomal dominant trait and thus 50% of the offspring would be expected to have this disease

d) Aetiology of chronic thyroiditis (Hashimoto's thyroiditis):

Hashimoto's thyroiditis is clearly autoimmune in nature and may be the most common autoimmune disorder as well This occurs as a painless diffuse goiter in young or middle age women and often presents as an incidental finding during routine physical examination

PATHOLOGY

1) Colloid (Adenomatoid) nodule

This goiter is mainly due to stimulation with increased TSH. TSH secretion is increased due to low level of circulating thyroid hormones. Simple goiter are more common in females than in males owing to the presence of estrogen receptors in thyroid tissue.

Persistent growth stimulation causes diffuse hyperplasia, all lobules are composed of active follicles and iodine uptake is uniform. If TSH stimulation ceases, the goiter may regress. The goiter is soft diffuse and may become large enough to cause discomfort. A colloid goiter is a late stage of diffuse hyperplasia when TSH stimulation has fallen off and follicle are inactive and full of colloid.

Latter as a result of fluctuating stimulation of TSH, a mixed pattern develops with areas of active lobules and areas of inactive lobules. Active lobules become more vascular and hyperplastic until hemorrhage occurs, causing central necrosis and leaving only a surrounding rim of active follicle. Necrotic lobules coalesce to form nodules filled either with iodine – filled colloid or mass of new but inactive follicles.

Continual repetition of this process result in a nodular goiter. Most nodules are inactive and active follicles are present only in the internodal tissue

Nodules are usually multiple forming a multinodular goiter. A toxic multinodular goiter usually develops in a large, long standing multinodular goiter of atleast 10 year duration, only one macroscopic nodule is found but

microscopic changes will be present throughout the gland, this is one form of clinically solitary nodule. Nodules may be colloid, cellular and cystic degeneration and haemorrhage are common as is subsequent calcification.

Adenomatous nodule

Appear like a circumscribed nodule of varying length. Commonly undergo cystic change .Focal areas of fibrosis and hemorrhage may be seen. Microscopically nodules are cluster of active looking follicles with focal areas of colloid cysts and hemosiderin laden with macrophages.

Toxic adenomatous nodule

On histological examination, large and small follicels lined by columnar and tall cubodial epithelical cell are alternatively formed.

2. Thyroid adenoma

Usually presents as a asymptomatic solitary nodule or with large mass with local symptoms Microscopically slow growing encapsulated solitary nodule with uniform histological architecture within the capsule. Areas of focal necrosis, hemorrhage may occur as retrogressive changes: It needs to be differentiated with MNG produce less compression of adjacent thyroid parenchyma and lack a well formed capsule. With evidence of vascular invasion and capsular invasion one should rule out Follicular carcinoma.

Adenomas can be classified into

- Follicular adenoma and its variants
- Papillary adenoma
- Atypical adenoma

a) Follicular adenoma:

Almost all thyroid adenoma show follicle formation to a varying degree; follicle adenoma are usually but may contain a variable amount of colloid; It is unknown whether follicular adenomas show transition over time to malignancy. Further investigations may be needed differentiate from follicular carcinoma

According to the size of follicles and the degree of follicle formation, follicular adenomas are further classified as i) Colloid ii) Simple iii) Fetal iv) Hurthle cell v) Embryonal

III) Malignant neoplasms of thyroid[82] :

Classification of malignant neoplasm of thyroid:

a) Well differentiated thyroid carcinoma;

i) Papillary carcinoma.

ii) Follicular carcinoma.

b) Poorly differentiated thyroid carcinoma;

i) Hurthle cell carcinoma.

ii) Variants of papillary carcinoma:

-Tall cell variant.

-Insular variant.

-Columnar variant.

c) Medullary carcinoma.

d) Undifferentiated (Anaplastic) carcinoma

a) Well differentiated thyroid carcinoma:

i) Papillary carcinoma of the thyroid [82]:

Papillary carcinoma is the most common thyroid carcinoma in both children and adults with incidence of 62%. It frequently presents in 4th and 5th decades with male to female ratio of 1:3. Multicentric tumour with lymphatic spread of primary tumour. Papillary carcinoma is associated with excellent prognosis (10 years survival rate is 95%).

Micro: Histologic diagnosis is made on the basis of papillary architecture or characteristic nuclear features. True papillae have fibrovascular core and are generally lined by single row of epithelial cells. Orphan Annie nucleus is characteristic. Sometimes occult malignancy may spread to lymph node causing isolated lymphnode enlargement(Lateral Aberrant Thyroid)

ii) Follicular carcinoma[82]:

It is the next most common thyroid carcinoma comprising 20-25%, incidence is less in iodine sufficient areas. They occur more commonly in women (F:M= 2.6:1), most often in middle aged or older individual. More aggressive tumour. While lymph node metastasis are unusual, a significant number of patients initially present with or subsequently develop distant metastasis.

Micro: Follicular carcinoma have a range of pattern similar to those found in follicular adenomas. Pleomorphism is not marked. Capsular and vascular invasion are characteristic. They may be i) encapsulated or minimally invasive carcinoma ii) widely invasive carcinoma

The prognosis of patient with encapsulated minimally invasive carcinoma is much better than for those with widely invasive carcinoma. It is found that metastasis developed in 2-3% and 25% of patient with minimally and widely invasive carcinoma respectively and cumulative death rate at 10 years was 3% and 32% respectively

Regional lymph node metastasis is unusual and distant metastases are much more common usually to be bone, lungs via hematogenous route

a) Poorly differentiated carcinoma

b) Hurthle cell carcinoma[82] **:** Hurthle cell carcinoma accounts for 3% of all thyroid malignancies is a subtype of follicular carcinoma that closely resembles follicular carcinoma. This occurs in older persons usually 60-70years of age. The tumor contains an abundance of oxyphilic cells or oncocytes under interpreted as nodular hyperplasia.

c) Medullary carcinoma

Medullary carcinoma accounts for 5 to 10% of thyroid malignancies. The malignancy involves the para-follicular cell or "c" cell derived from neural crest. This can occur in sporadic form (non- familial) (80%) or as a part of MEN type 2A or 2B, Sporadic cases are more common in women while

familial cases are autosomal dominant and affect both sexes equally. In sporadic cases, the lesion usually within one lobe where as men involves upper halves of both lobes.

Medullary thyroid tumors secrete not only calcitonin and carcino-embryonic antigen (CEA) but also calcitonin gene related peptide (CGRP), histaminadases, prostaglandins E2 and F2a and serotonin. The calcitonin excess is not associated with hypocalcemia. The presence of both a mass and an elevated calcitonin level is diagnostic of medullary carcinoma. Calcitonin is more sensitive tumor marker but CEA is a better predictor of prognosis. Screening for pheochromocytoma with 24 hour urinary catecholamines is mandatory in any patient whose thyroid mass is suspected as being medullary thyroid carcinoma.

Medullary carcinoma invades locally and gives rise to metastsis in cervical and mediastinal lymph nodes(50%) and also in distant organs (15-25%) particularly in lung, liver and skeletal system.

Micro: The classic presentation is represented by a solid proliferation of round to polygonal cells of granular amphophilic cytoplasm and medium sized nucleus, separated by a highly vascular stroma, hyalinized collagen and amyloid. The nuclei resemble those of neuroendocrine tumours in other areas of body. They are usually round and stippled "pepper and salt" chromatin.

d) Anaplastic carcinoma[82,83]:

Anaplastic thyroid carcinoma represent less than 1% of all thyroid malignancies. This occurs in 7^{th} or 8^{th} decade. It is most aggressive from with

dysphagia, cervical tenderness and painful neck mass. Superior venacava syndrome can also be part of presentation regional lymph nodes are frequently enlarged. Distant metastases to lungs and bones are common

e) Lymphomas

Lymphomas account for less than 1% of thyroid malignancies and most are of the non-B-cell type.

iv) Thyroid cyst: About 50% of cystic swelling are idiopathic . FNAC is done as therapeutic and diagnostic procedure. USG may be used to identify suspicious cysts. Reaccumulation is common. Few may need surgery.

v) Thyroiditis:

Includes the following types namely:

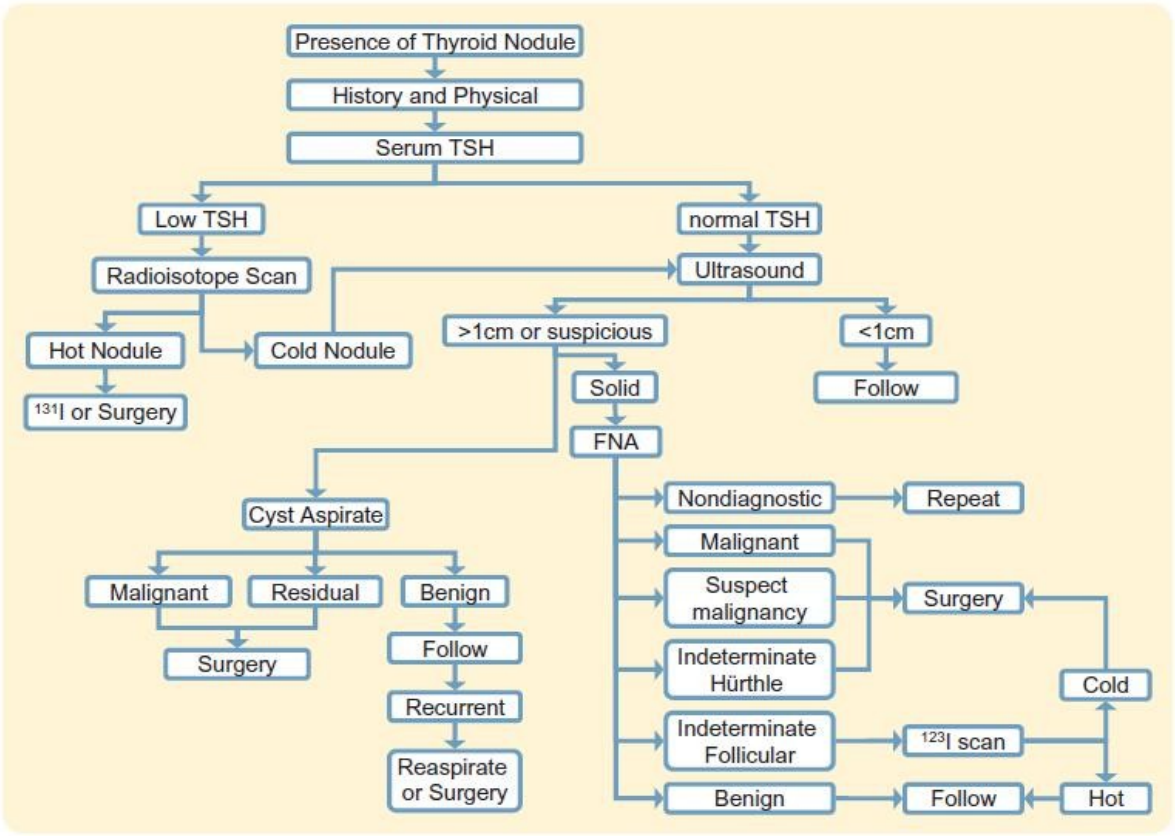
1. Chronic lymphocytic thyroiditis (Hashimoto thyroiditis).
2. Sub-acute lymphocytic thyroiditis or Post-partum thyroiditis.
3. Sub acute granulomatous thyroiditis (de-Quervain's thyroiditis).
4. Acute suppurative thyroiditis.
5. Invasive fibrous thyroiditis(Riedel's thyroiditis).

TNM STAGING

Primary Tumor (T)[a]	
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
T1	Tumor ≤2 cm confined to the thyroid
T1a	Tumor ≤1 cm confined to the thyroid
T1b	Tumor 1–2 cm confined to the thyroid
T2	Tumor >2 cm and <4 cm confined to the thyroid
T3	Tumor >4 cm confined to the thyroid *or* tumor of any size with minimal extrathyroid extension
T4a	Moderately advanced disease. Tumor of any size extending beyond the thyroid capsule to invade subcutaneous soft tissues, larynx, trachea, esophagus, or recurrent laryngeal nerve *or* Intrathyroidal anaplastic carcinoma[b]
T4b	Very advanced disease. Tumor invades prevertebral fascia or encases carotid artery or mediastinal vessels *or* Extrathyroidal anaplastic carcinoma[b]
Regional Lymph Nodes (N) (Central Compartment, Lateral Cervical and Upper Mediastinal)	
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Regional lymph node metastasis
N1a	Metastasis to level VI (pretracheal, paratracheal, and prelaryngeal/Delphian lymph nodes)
N1b	Metastasis to unilateral, bilateral, or contralateral cervical (levels I, II, III, IV or V) *or* retropharyngeal or superior mediastinal lymph nodes (level VII)
Distant Metastasis (M)	
MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis

PAPILLARY AND FOLLICULAR				*Medullary carcinoma*			
Under 45 years of age				Stage I	T1	N0	M0
Stage I	Any T	Any N	M0	Stage II	T2	N0	M0
Stage II	Any T	Any N	M1		T3	N0	M0
45 years of age and over				Stage III	T1	N1a	M0
Stage I	T1	N0	M0		T2	N1a	M0
Stage II	T2	N0	M0		T3	N1a	M0
Stage III	T3	N0	M0	Stage IVA	T4a	N0	M0
	T1	N1a	M0		T4a	N1a	M0
	T2	N1a	M0		T1	N1b	M0
	T3	N1a	M0		T2	N1b	M0
Stage IVA	T4a	N0	M0		T3	N1b	M0
	T4a	N1a	M0		T4a	N1b	M0
	T1	N1b	M0	Stage IVB	T4b	Any N	M0
	T2	N1b	M0	Stage IVC	Any T	Any N	M1
	T3	N1b	M0	*Anaplastic carcinoma*			
	T4a	N1b	M0	Stage IVA	T4a	Any N	M0
	T4a	N1b	M0	Stage IVB	T4b	Any N	M0
Stage IVB	T4b	Any N	M0	Stage IVC	Any T	Any N	M1
Stage IVC	Any T	Any N	M1				

Workup of a solitary thyroid nodule



INVESTIGATIONS

ROUTINE INVESTIGATIONS

As in other general surgical cases, routine investigations like blood analysis (Hb%, BT, CT), urine analysis, radiological assessment of chest are done to assess the fitness of the patient to undergo major surgical procedure.

SUPPORTIVE INVESTIGATIONS

1. **ECG**: In hypothyroid state, low voltage, flattened ST wave or inversion of T waves are seen. In hyperthyroidism sinus tachycardia, atrial tachycardia, atrial fibrillation and signs of left ventricular hypertrophy may be seen.
2. **Serum cholesterol**: In hypothyroidism, it is markedly increased (more than 300 mg%).
3. **Indirect laryngoscopy:** Routine laryngoscopic examination should be made before thyroidectomy. Pre-operative detections of vocal cord paralysis is essential. It also helpful in diagnosing involvement of recurrent laryngeal nerve.
4. **Radiological investigation:** Radiography of neck is helpful in determining the position of trachea, retrosternal extension and also calcification in the nodule. Calcification is seen in long standing adenomatous goiter and papillary carcinoma and extensive calcification in nodular goiter.

SPECIFIC INVESTIGATIONS

5) Tests for thyroid function:

Most of the patients with solitary thyroid nodule are euthyroid, but laboratory confirmation of this is generally agreed that no single procedure, consistently yields reliable basis for diagnosis and therefore, a combination of various tests are generally required.

i) Thyroid function tests:

The most useful index of thyroid function is the direct measurement of circulating thyroid hormones. Total T4 and total T3 are designated T4 and T3 respectively. These are measured by radioimmune assays.

Normal values : T4 : 55-155 nmol/lit ,T3 : 1-nmol/lit.,

ii) Free thyroid hormone measurements:

FT4 can be measured by two methods: equilibrium dialysis or radio immunoassay (RIA). Dialysis methods is the gold standard is restricted to research laboratories as it is time consuming and only a small number of samples can be processed. Simultaneously ft4 measurements by RIA is valuable and it provides an excellent index of thyroid status in almost any clinical situations. Normal FT3 is 1.3-3.5 nmol/l and FT4 is 170-160 nmol/l (12-28 pmol/l).

iii) Serum thyroid stimulating hormone (TSH):

Another very sensitive test of thyroid function is the serum TSH value. This is measured by immunoassay technique. The normal serum TSH level is 0.3-5miu/l. It is raised in primary hypothyroidism (may be over 40 miu/l) and

almost undetectable in hypothyroidism. It is the most sensitive test of primary hypothyroidism.

iv) Radioiodne uptake (RAIU) test:

Routine isotope scanning has been abandoned except when toxicity is associated with nodularity. It is used delineating the presence , size and function of thyroid nodules. I^{131} (half life of 8 to 10 days, dose of 5 mCi)is used for distant metastasis screening in well differentiated thyroid carcinoma. Depending upon uptake a) Hot nodule (hyperfunctioning) (5%). b) Warm or neutral nodule (10-15%). The incidence of malignancy in 9%.c)Cold nodule (hypo functioning) (80-85%). The incidence of malignancy is 15- 20%.

6) Ultrasonography: Ultrasound is a simple, rapid, relatively cheap and noninvasive method to study the structure of thyroid. High resolution ultrasonography (7.5 to 10 MHz) is used. It can pick up impalpable nodules as small as 0.3 cm in diameter. USG is useful in distinguishing between solid and cystic lesions, malignant and benign lesions. FNAC can also be taken under USG guidance. Benign lesion nodule shows "hallow sign " on USG and features suggestive of malignancy include hyperchoic pattern in complete peripheral halo, irregular margins and microcalcifications.

7) Computerized tomography and magnetic resonance imaging:

There is no place for CT scanning and MRI in routine evaluation except to determine the extent of a large cervical or retrosternal thyroid and spinal metastases.

8) Tissue diagnosis:

a) Fine needle aspiration cytology (FNAC):

FNAC is a highly accurate and cost effective diagnostic technique of low morbidity providing a valuable to clinical assessment in overall selection of patients with thyroid nodules for surgery. The sensitivity of FNAC for detection of malignant lesions is approximately 83% and the specificity is about 92%. Problems with FNAC include difficulty in

* Follicular lesions (benign Vs malignant).

* Hurthle cell lessions (benign Vs malignant).

*Lymphocytic lesions (lymphocytic thyroiditis Vs lymphoma)

b) Core needle biopsy:

Only indicated in Lymphoma and Hard fixed thyroid swelling in conclusive with FNAC, otherwise not routinely indicated

9) Serum Thyroglobulin (Tg): Normal levels 1-43 ng/ml.

Used in the post operative follow up after total thyroidectomy to indicate recurrences (Tg> 10 ng/ml)

10) Serum Calcitonin:

Calcitonin hormone secreted by para-follicular C-cells serves as useful marker in detection and follow up of medullary carcinoma.

11) Measurement of antibodies:

About 95% of patients with Hashimoto's thyroiditis and 80% with Grave's disease have detectable anti-microsomal antibodies.

TREATMENT

The optimal management of the solitary nodule of thyroid continues to be a source of controversy and operative intervention recommended by most surgeons. Though the majority of nodules are benign, a significant proportion 10-30%, are malignant carcinoma of thyroid. The common indications for surgery in a solitary nodule are as follows :

1. Pressure effects irrespective of aetiological diagnosis
2. Malignancy
3. Cosmesis

The treatment for different aetiological entities

1] **Adenomatous non–toxic nodules**

As the basic cause is diminished synthesis of thyroxine should be treated by thyroxine replacement therapy (0.1- 0.2 mg /day) with periodic montoring of nodule regression and serum levels of T3, T4 and TSH be measured at regular intervals. Surgery (Hemithyroidectomy)is indicated for the above mentioned reasons and post op thyroxine replacement is given.

2] **Lymphocytic thyroiditis:**

It eventually result in hypothyroidism, treatment is essentially conservative with; oral thyroxine substitution therapy by monitoring the serum levels of T3, T4, TSH. Surgery is indicated for pressure effects by a large nodule or for cosmesis.

3) Toxic nodule:

It is an autonomously functioning thyroid nodule that produces hyperthyroidism. Toxic nodule can be treated by surgery after making patient euthyroid or by radioactive iodine therapy.

4) Thyroid cyst:

About 15% of all thyroid nodules are cystic. Majority of them (97%) are benign. FNAC and USG of neck are the common investigations done. Presence of solid remnants warrants to rule out malignancy Simple thyroid cysts resolve with aspiration in approximately 75% of cases, although some require second or third aspiration Surgery is indicated in cyst > 4 cm, failed aspiration in 3 attempts, solid components in cyst

5) Benign neoplasms:

FNAC is difficult to differentiate between adenocarcinoma and adenoma preoperatively. If post op HPE after hemithyroidectomy is indicative of carcinoma completion thyroidectomy is done

6) Treatment of thyroid carcinoma:

i) Treatment of papillary and follicular carcinoma:

A) Surgery (Total thyroidectomy/Near total thyroidectomy):

The procedure involves removal of the entire thyroid gland with identification and preservation of recurrent laryngeal nerves and parathyroid glands.

PROCEDURE OF THYROIDECTOMY

INDICATIONS

Subtotal thyroidectomy is indicated in

1) High risk patients with SNT
2) Presence pressure symptoms
3) For cosmesis in large nodule
4) Toxic goiters
5) Rarely for Riedel's struma and Hashimoto's disease.

Patient is optimized pre-operatively to euthyroid status.

ANAESTHESIA

General Anaesthesia administered through endotracheal intubation is preferred.

POSITION OF PATIENT

The patient is placed in a neck extended position by placing sandbag/ folded sheet /inflatable thyroid pillow under the shoulders .The occiput is lowered on to a head ring. The hands are tucked to the to sides of patient. Reverse trendlenberg position is also used (Head tilt of 15 degrees). Mesh cap is used to cover patient hair.

Figure 1

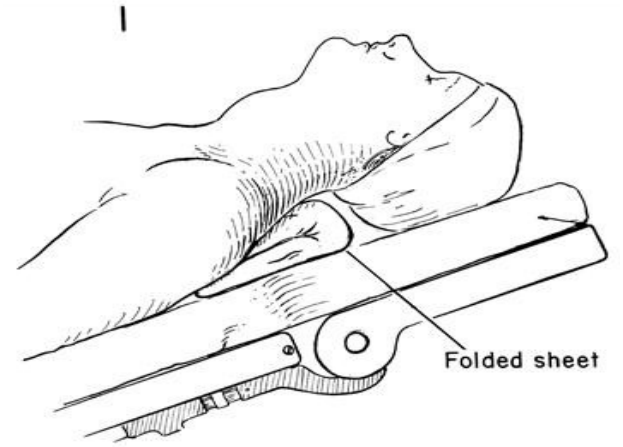
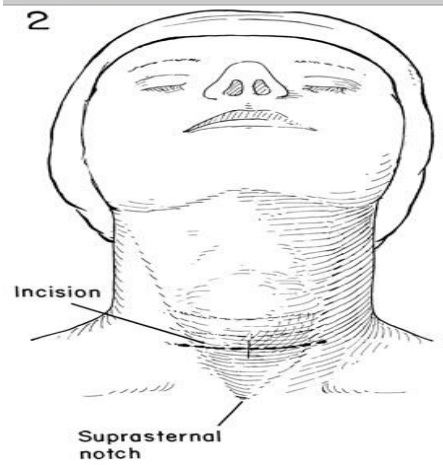


Figure 2



The transverse incision is marked with silk thread about two fingers above the sternal notch extending upto borders of the sternocleidomastoid muscles. Incision is higher up for large goiters. Draping with sterile towel is done.

INCISION AND EXPOSURE

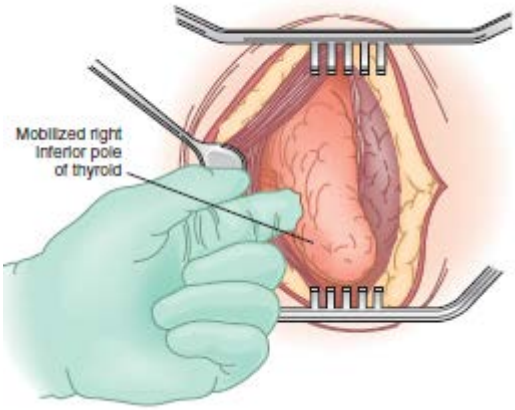
The surgeon stands to the right of patient. A dry field is maintained if the various fascial planes are carefully considered during the procedure.

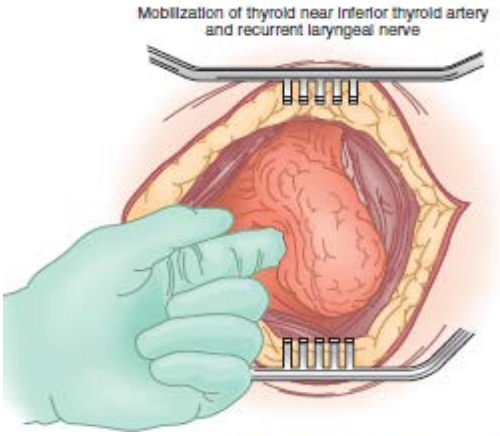
The skin incision is made two finger breadth from suprasternal notch. Skin, subcutaneous tissue divided. Subplatysmal plane is reached after deepening the incision. Flaps are raised both superiorly and inferiorly in that plane with care taken to avoid undue injury to the Anterior Jugular vein .Superior flap is raised upto the thyroid notch and inferiorly upto suprasternal notch. Skin flaps are held by self retaining retractors. Investing layer of deep cervical fascia is divided vertically in midline. Strap muscles are retracted after separating fascia adjoining them. Large goiters necessitate

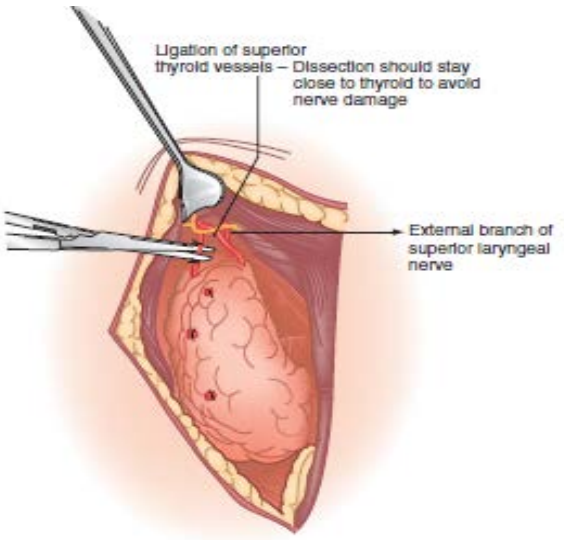
division of strap muscles of neck for access. Dissection is done to achieve a cleavage between sternothyroid and thyroid gland facilitating a thin fascia which is held up and divided. This exposes the thyroid gland with its capsule and blood vessels. Prethyroid muscles are retracted. Right upper pole is dissected first, blunt dissection is done to push thyroid capsule away to expose the superior pedicle . The superior pedicle is skeletonised and ligated close to the gland ensuring to avoid injury to superior laryngeal nerve. Middle thyroid vein should be identified and ligated to avoid bleeding due to undue traction of gland. Next the lower pole is dissected on the right side by blunt dissection. The inferior thyroid vessels are identified and ligated, avoiding injury to recurrent laryngeal nerve. Thyroidea ima veins sometimes encountered in lower pole are dissected and ligated. Alternatively lower pole may be ligated first before dissecting upper pole. Ligation is applied and cut. Parathyroids are encountered at the posterior surface of gland, and are usually preserved. Superior is close to thyroid cartilage and inferior close to inferior pole. The gland is lifted and retracted and hemostats are placed across the gland and dissection is done to separate gland from trachea. Plane of cleavage is created between trachea and gland and gland is separated from trachea . Isthmus is then divided. Horizontally oriented clamps prevent injury to recurrent laryngeal nerve. Hemostasis is secured and saline wash is given to identify bleeders. Opposite lobe is dealt similarly.

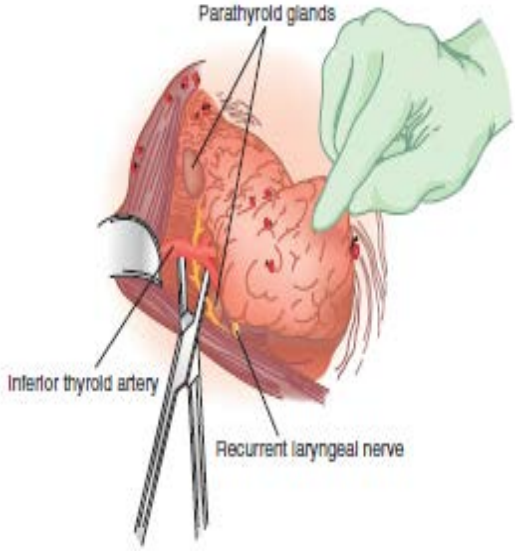
CLOSURE

Extended neck is released to verify for bleeding. Closed suction drain is placed in thyroid bed to prevent any fluid collection. The sternothyroid and sterno hyoid are then approximate. Drain is brought out through centre beneath incision through stab wound. Remaining wound is closed in layers. Skin is closed with subcuticular sutures with non absorbable sutures.









POSTOPERATIVE CARE

Laryngoscope is inserted to view vocal cord status and extubation is done. Oxygen is given at 4 to 5 L per minute, until the patient has reacted. Patient's breathing is monitored and any respiratory distress or stridor warrants immediate intervention . Parenteral fluids are given till oral liquids are well torable. Injection Calcium Gluconate is added.

Early complications include

1) Hemorrhage

2) hoarseness and temporary aphonia

3) vocal cord paralysis

4) postoperative thyroid "storm."

If hemorrhage is suspected wound is opened and hemorrhage is let out followed by identification of bleeders and ligation.

Recurrent laryngeal nerve bilateral leads to vocal cord paralysis of both vocal cords tracheostomy.

Postoperative toxicosis is managed by corticosteroids, propanolol and cooling blankets. Hypoparathyroidism is managed by calcium gluconate 10% intravenously along with Vitamin D2 is administered normalise serum calcium level. Thyroid replacement is given with levothyroxine daily. Drains are removed in first postoperative day. Patients are discharged after suture removal.

Management of Lymph nodes

The current practice of the vast majority of endocrine surgeons with regard to well-differentiated thyroid cancer is to perform node dissection in the setting of imageable or palpable nodal disease. If a neck dissection is performed, the preferred approach is a modified radical neck dissection type III preserving the internal jugular vein, sternocleidomastoid muscle, and accessory nerve in the vast majority of patients.

Post op management

i. Suppressive therapy with thyroxine

Post-operative thyroid hormone replacement is necessary after total or near total thyroidectomy or ablation with radio-iodine. Thyroxine is necessary not only as replacements therapy in patients total thyroidectomy but has additional effect of suppressing TSH and reducing growth stimulus for any possible residual thyroid cells. TSH suppression(< 0.1 microU/Ml) reduces tumor recurrence rates particularly in young patients with thyroid cancer.

ii. Use of RAI post-operatively

All patients who have undergone a total or near-total thyroidectomy for a papillary or follicular carcinoma larger than 1.0 to 1.5 cm should be considered candidates for radio-iodine ablation ^{131}I for ablation are given in two doses. Selectively young patients are given repeated ^{131}I ablation at a dose of < 30 mCi. Higher ablative doses ranging from 100 to 150 mCi should be used for older, high-risk patients, particularly those known to have an incomplete resection of the primary tumor, an invasive primary tumor, or metastases.

Postoperative ablation is typically performed approximately 6 weeks after near- total or total thyroidectomy

Complications of RI

Acute:

1) Radiation thyroiditis

2) Pain in bone and other distant metastasis induced by radiation inflammation.

3)Tumor edema / haemorrhage.

Late:

1) Damage to gonads, 2) bone marrow lungs, 3) induction of other malignancies like bladder carcinoma, leukemia

iii. Serum thyroglobulin measurements;

This is done 3 months after surgery. Since even small amount of normal residual thyroid CA can produce significant quantity of thyroglobulin, complete extirpation of the gland followed by radioactive iodine ablation is mandatory. If the values go above 10 ng/ml it is suggestive of metastasis or persistent normal thyroid tissues.

iv. Chemotherapy

Chemotherapy is not effective. Only indication is unresectable disease. The best single chemotherapeutic agent for this tumor is doxorubicin (Adriamycin).

v. Treatment of Anaplastic thyroid carcinoma

At the time of diagnosis 80% will have lymph node metastases 25-50% of patients may have synchronous metastases survival after the diagnosis of ATC is very poor with the median survival in most series being less than 5 months;

Early diagnosis with aggressive surgical therapy supplemented by external-beam radiation therapy and doxorubicin based chemotherapy is regarded by many as the most appropriate treatment.

vi. Treatment of thyroid lymphoma

Patients with thyroid lymphoma respond rapidly to chemotherapy [CHOP] – cyclophosphamide, doxorubicin, vincristine and prednisone] which is also associated with improved survival combined treatment with radiotherapy and chemotherapy is often recommended

vii. Medullary carcinoma

Preoperative diagnosis of medullary carcinoma warrants syndromic evaluation of MEN 2 a/ 2b. Pheochromocytoma should be identified with urinary catecholamines and isotope scans. Treatment for pheochromocytoma is done first. Medullary carcinoma of thyroid is treated with total thyroidectomy and central neck node dissection. Chemotherapy and external beam radiotherapy are ineffective.

Progonosis

Most patients with papillary carcinoma can be expected an excellent prognosis, with the 10-years survival rate approaching 95% for the most favorable stages. The clinical findings and pathologic staging, however, may alter the

excellent prognosis. In 1979, Cady and associates introduced AMES and Mayo clinic introduced AGES scoring systems. Both the AMES and the AGES clinical scoring systems have proved beneficial in predicting the prognosis of papillary and follicular cancer.

Table 38-4 Prognostic Risk Classification for Patients With Well-Differentiated Thyroid Cancer (AMES or AGES)

	Risk	
PARAMETER	**LOW**	**HIGH**
Age (yr)	<40	>40
Gender	Female	Male
Extent	No local extension, intrathyroidal, no capsular invasion	Capsular invasion, extrathyroidal extension
Metastasis	None	Regional or distant
Size	<2 cm	>4 cm
Grade	Well differentiated	Poorly differentiated

AGES, ***A****ge,* ***p****athologic grade of tumor,* ***e****xtent and* ***s****ize of the primary tumor;* *AMES,* ***a****ge, distant* ***m****etastasis,* ***e****xtent of primary tumor,* ***s****ize of primary tumor.*

MATERIALS AND METHODS

The present study on "Clinical Study of Solitary Nodule of Thyroid" has been conducted by utilizing cases admitted and managed in the Department of Surgery at Govt. Royapettah Hospital attached to Govt. Kilpauk Medical College Hospital, Chennai over a period of 10 months from November 2014 to Sep 2015.

Descriptive analysis of 50cases of solitary nodule thyroid in the specified period done. These cases were selected by random sampling method and studied in detail clinically and recorded as per the proforma. Routine investigations and specific investigations including FNAC of the nodule, Thyroid profile, IDL, Plain X-ray neck, USG neck were done in all cases. Special investigations like radio-isotope scanning was not performed as the facilities were not available. All the patients were managed by surgery and diagnosis was confirmed by histo-pathological examination.

- ***Inclusion criteria:***
- Patients above the age of 12 years.
- Patients presenting clinically with solitary nodule thyroid
- Both male and female patients are included in study
- ***Exclusion criteria:***
- Patients below the age of 12years
- Patients clinically with multi nodular goitre
- Patients with lateral aberrant thyroid
- Patients have diffuse swelling of thyroid

The patients were grouped according to different variables like age , sex, size of the nodule, site of the nodule, functional thyroid status, FNAC reports and histo- pathological examination reports, then analyzed and compared with the previous similar studies conducted elsewhere. Finally conclusions were drawn accordingly.

Treatment:

Preoperative

Use of anti-thyroid drugs, beta-blockers, blood transfusions or any other medications were prescribed based on individual status and was noted

Operative

Position of the patient, type of anaesthesia, incision, type of operation planned, per- operative findings and type of operation performed were recorded.

Post-operative

Every patient was followed up post-operatively during the course of management in the hospital to note the development of and management of complications.

Follow-up

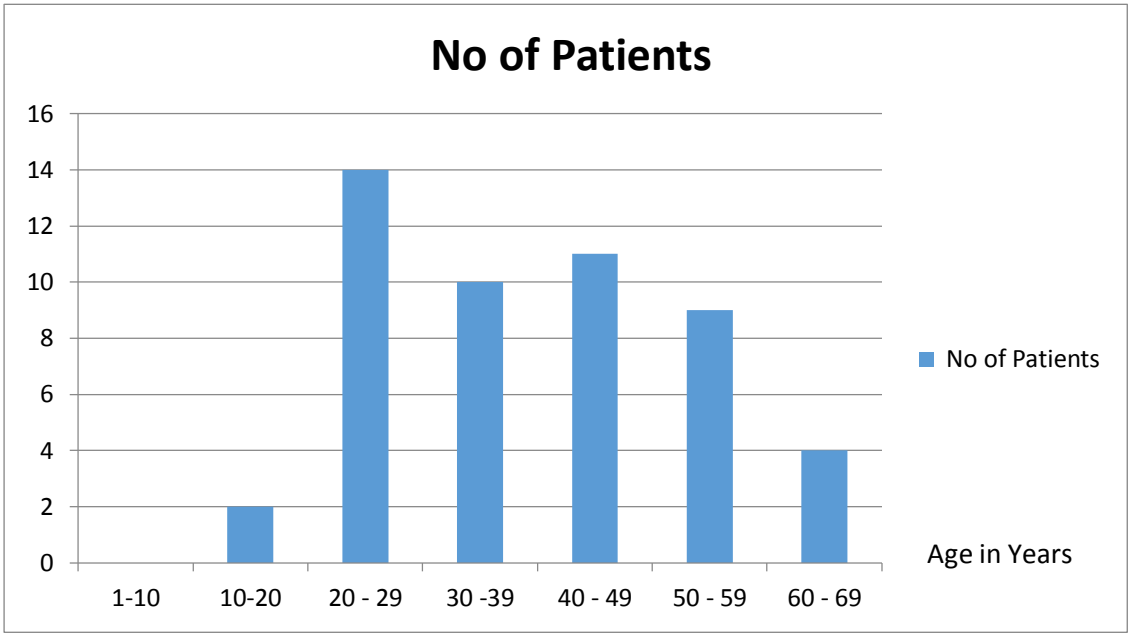
At the time of discharge, all the patients were advised to attend the surgical OPD regularly for follow up. Any recurrences or complications were noted. Thyroid functional status was assessed, accordingly thyroxine tablets prescribed if necessary.

RESULTS

Total of 50 cases of solitary nodule of thyroid studied and following conclusions were drawn:

Age Incidence:

AGE IN YEARS	NO. OF PATIENTS
0-9	0
10-19	2
20-29	14
30-39	10
40-49	11
50-59	9
60-69	4
Total	**50**



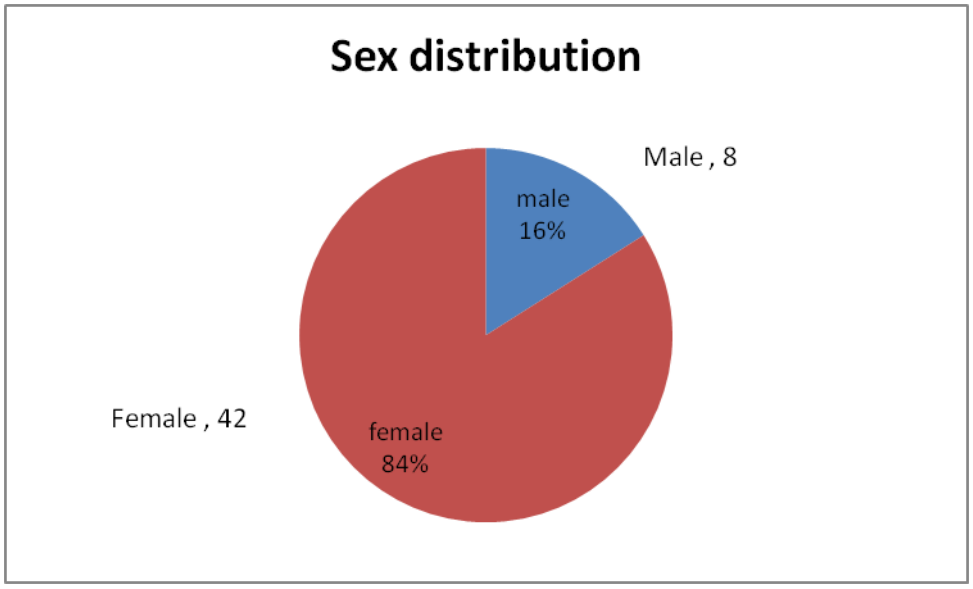
Age Incidence:

The age of the patients ranges from 18 years to 66 years, with peaks being in 3rd to 5th decades. The mean age of presentation is 37.26 years. Cases in 3rd to 5th decades constitutes 60% of the cases studied.

Sex Incidence:

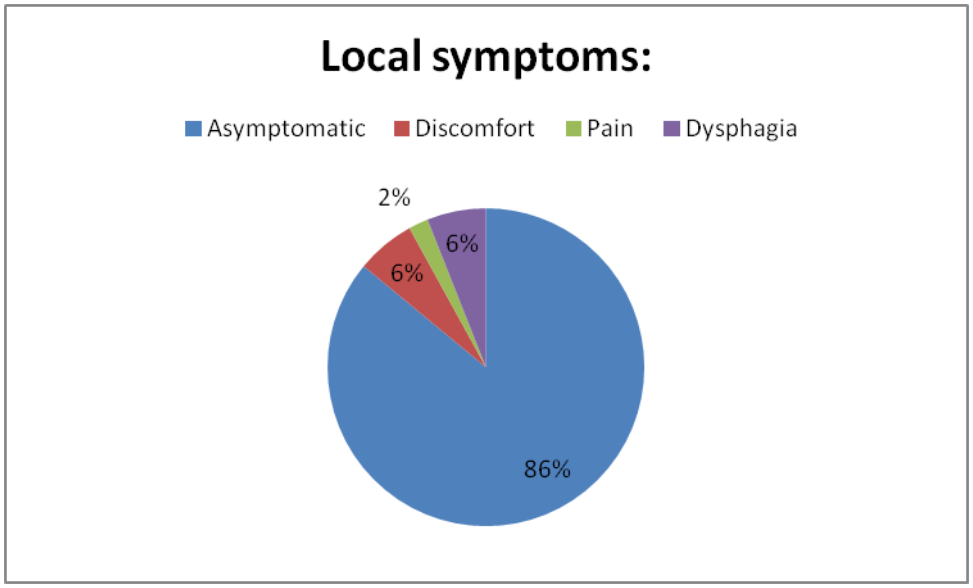
Solitary nodule of thyroid are much more common in females. Out of 50 cases studied 42 were females and 8 were males, and the ratio comes to M : F = 1 : 5.25. Also the malignant nodules are common in females. Out of 9 cases of malignancy in the study, 8 were females.

SEX	NO. OF PATIENTS
MALES	8
FEMALES	42
Total	50



CLINICAL FEATURES

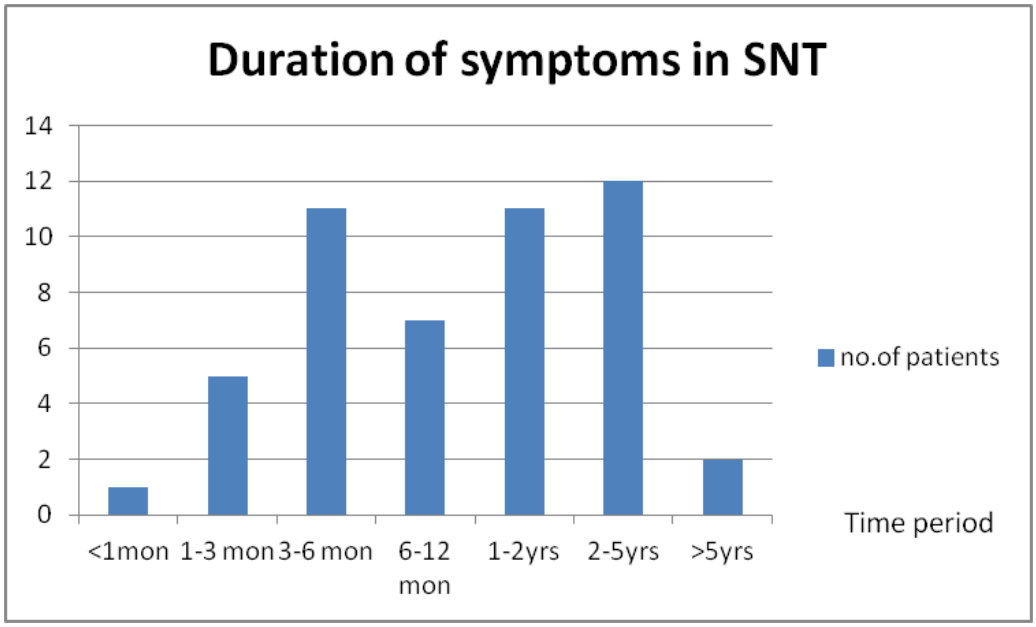
All the cases in the present study presented complaint of swelling in the region of the thyroid. Only few patients presented with pain, discomfort and dysphagia. All the mentioned additional symptoms were of mild degree. Out of 50 cases, 3 cases had pain, 3 cases had discomfort and another 1 had dysphagia. Also none of the patient had lymphadenopathy which was confirmed by ultrasonographic examination. Two patients had symptoms of thyrotoxicosis, and one had features of hypothyroidism. The latter patients' thyroid profile confirmed the functional status



Duration of symptoms:

In our study, duration of onset symptoms varied from 15 days to 8 years. Also duration of malignant nodules extend from 1 month to 4 years.

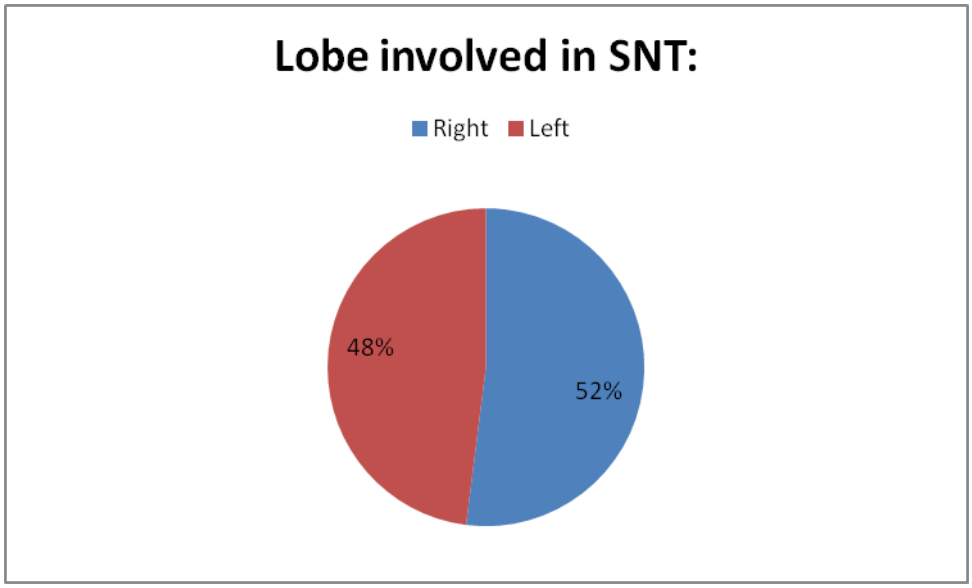
DURATION OF SYMPTOMS	NO. OF PATIENTS
<1MON	1
1-3 MON	5
3-6 MON	11
6-12 MON	7
1-2YRS	11
2-5YRS	12
>5YRS	2
Total	**50**



SITE OF THE NODULE:

Out of 50 cases studied, 26 cases presented with nodule in right lobe of the thyroid gland and the remainder 24 in the left lobe of thyroid. One patient among left sided solitary nodule had undergone right lobectomy 30 years back and presented with recurrent nodule in the rest of the lobe.

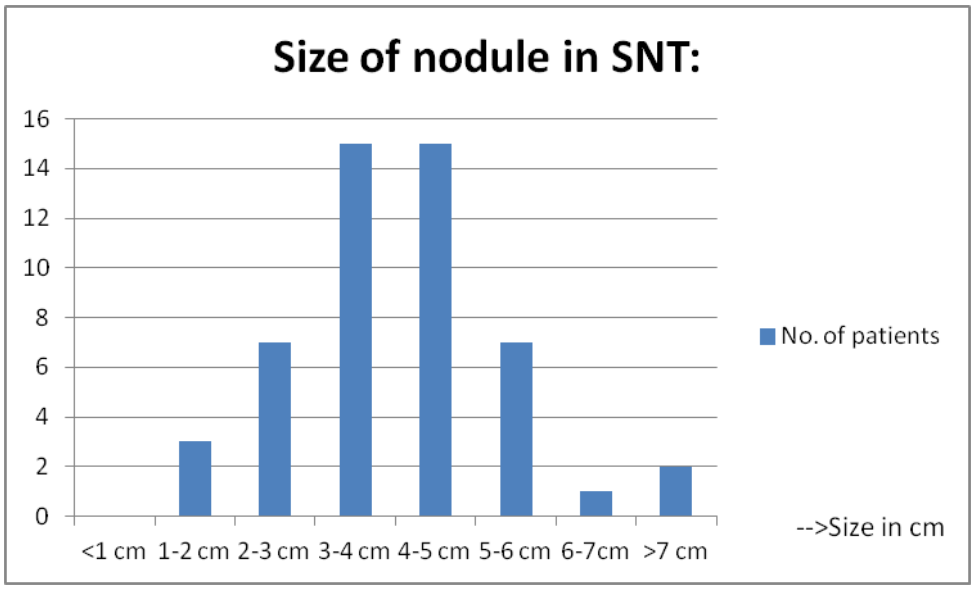
SITE OF THE NODULE	NO. OF PATIENTS
RIGHT	26
LEFT	24
Total	**50**



Size of the nodule:

In the present study, on clinical examination size of the nodule, in its largest dimension, varies from 2cm to 12cm. Most of the patients presented with the size of about 3 to 5 cm. in the study, as such there is no correlation between the size of the nodule and the occurrence malignant nodule.

Size of the nodule	No. of patients
<1 cm	0
1-2 cm	3
2-3 cm	7
3-4 cm	15
4-5 cm	15
5-6 cm	7
6-7cm	1
>7 cm	2
Total	**50**

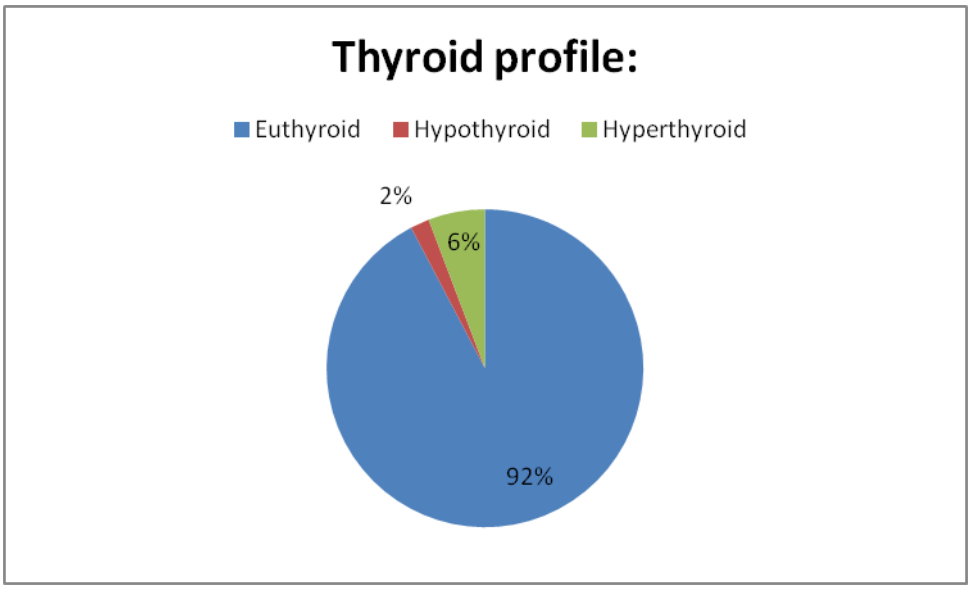


Thyroid functional status:

Out of 50 cases, two presented with features of thyrotoxicosis, one with hypothyroidism and rest all were in euthyroid state. Patients with thyrotoxicosis were made euthyroid using antithyroid drugs and operated and both cases turned out to be toxic follicular adenoma. Patient with hypothyroidism was treated with thyroxine.

USG neck revealed multiple nodules and managed by near subtotal thyroidectomy, and histopathological examination confirmed the diagnosis of multi-nodular goiter.

Thyroid functional status	No. of patients
Euthyroid	47
Hyperthyroid	2
Hypothyroid	1
Total	**50**



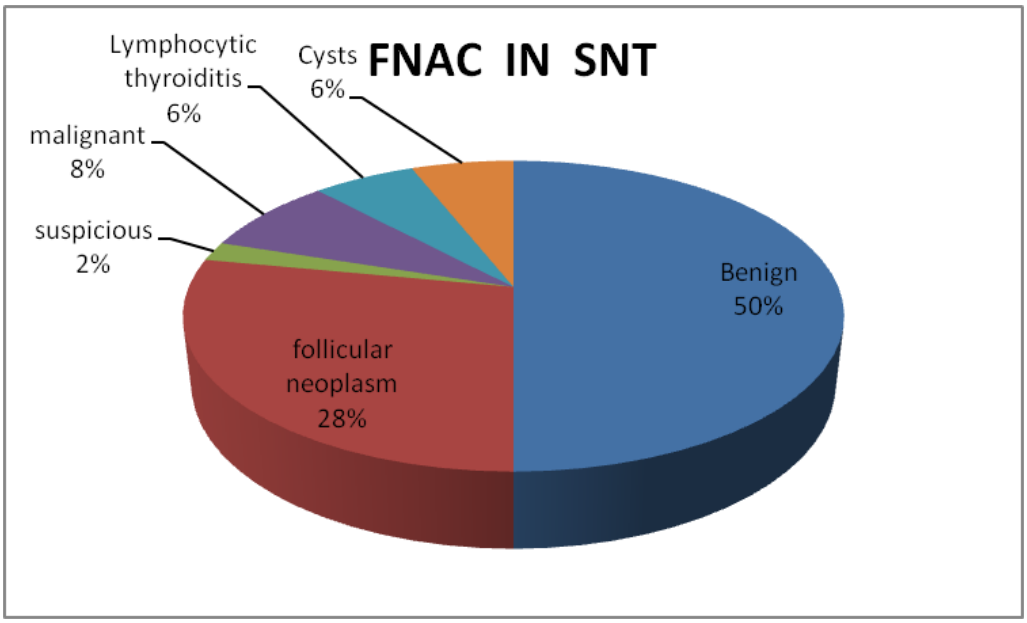
FNAC Reports:

Fine Needle Aspiration Cytology is the important investigation in the evaluation of solitary nodule of thyroid. All 50 cases were subjected to FNAC during the course of evaluation. Fnac reports are mainly categorized into 6 entities- Benign, follicular neoplasm, suspicious(of malignancy), malignant, lymphocytic thyroiditis, cysts. In our study, out of 12 follicular neoplasms, 4 turned out to be

follicular carcinoma. One suspicious (of papillary carcinoma) case confirmed papillary carcinoma on histopathological examination. 5 cases of papillary carcinoma were diagnosed pre- operatively by FNAC alone.

Two cases diagnosed as cysts by FNAC confirmed to be simple cysts on histopathological examination.

FNAC reports	**No. of patients**
Benign	25
follicular neoplasm	14
Suspicious	1
Malignant	4
Lymphocytic thyroiditis	3
Cysts	3
Total	**50**



Aetiological incidence of solitary nodule of thyroid:

Out of 50 cases studied, common causes of solitary nodule are MNG, follicular adenoma and adenomatous goiter; the most common being MNG which constitutes about 26% of cases.

Follicular adenoma and adenomatous goiters found almost at the same incidences, accounting to 24% each.

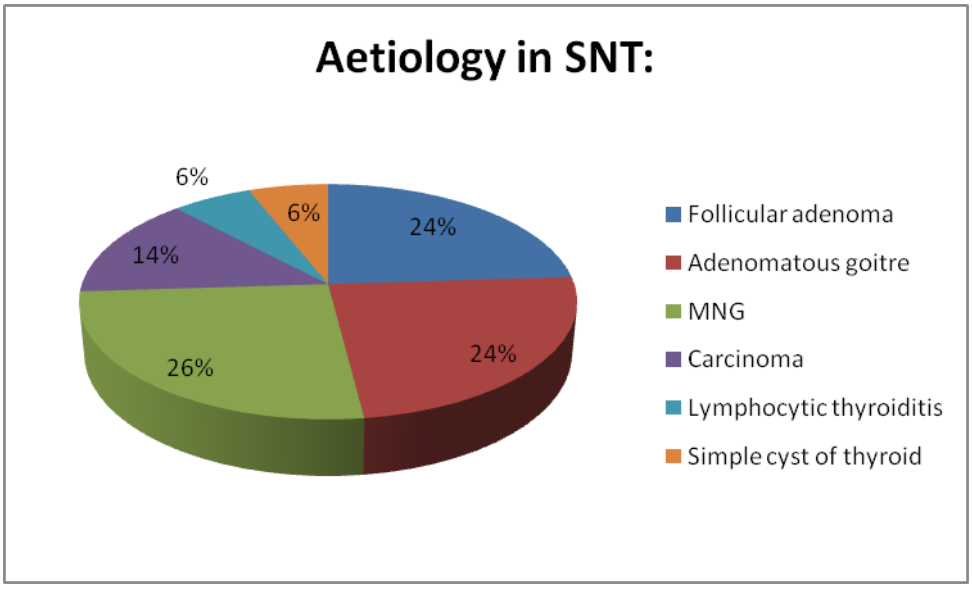
Out of 50 cases, nine were malignant – 5 papillary carcinoma and 4 follicular carcinoma.

45 patients were subjected to surgery. **5 patients (2 simple cysts & 3 Lymphocytic thyroiditis**) were conservatively managed. HPE reports of 45 were documented

Ultrasonography detected suspicious findings in two cases among six malignant cases – 1 papillary and 1 follicular.

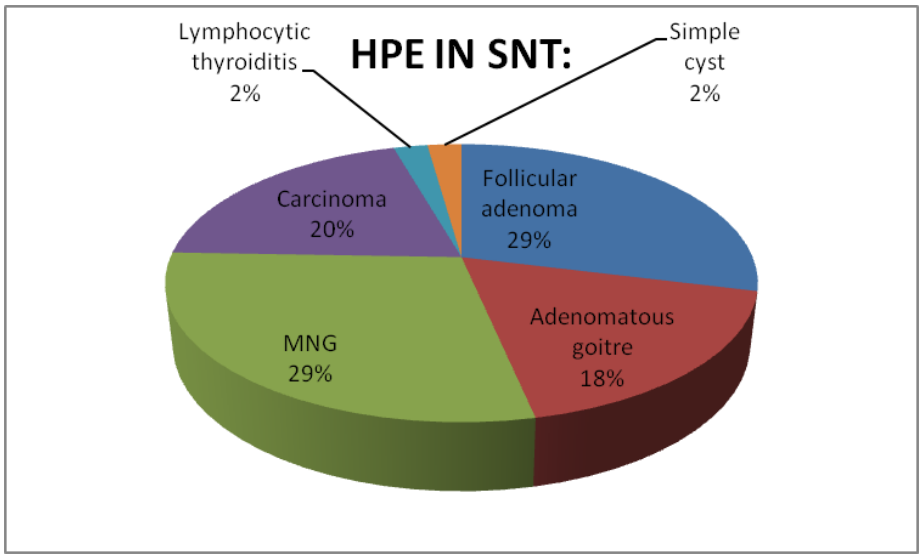
Three cases of papillary carcinoma were diagnosed with certainity by FNAC, one case was suspicious which turned out to be papillary CA on histopathological examination.

Two cases of follicular carcinoma were diagnosed follicular neoplasm, one of them showed suspicious features on ultrasonographic examination.



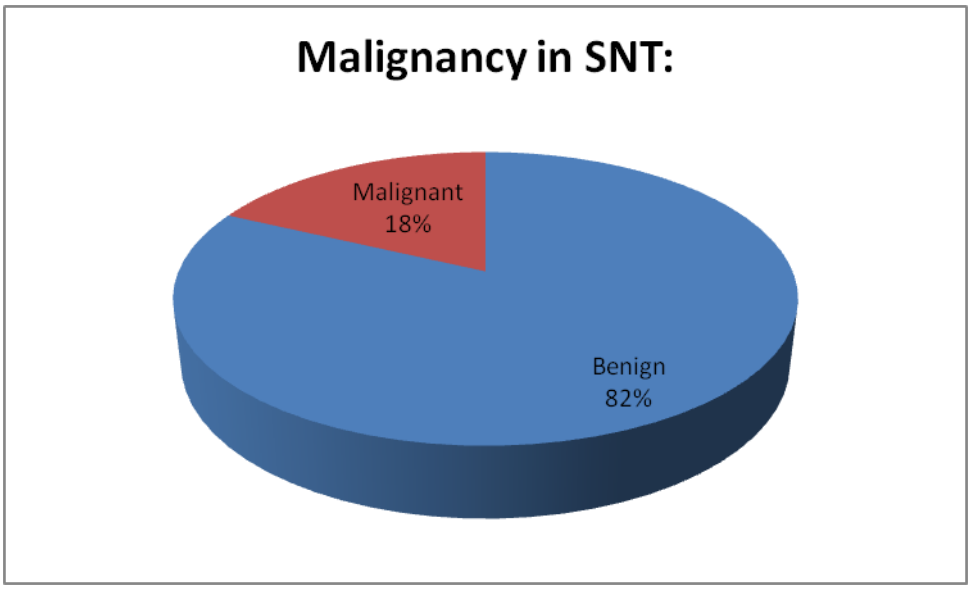
Post Operative Histopathology in SNT

HPE Reports	No. of patients
Follicular adenoma	13
Adenomatous goitre	8
MNG	13
Carcinoma	9
Lymphocytic thyroiditis	1
Simple cyst	1
Total	**45**



From the study, incidence of malignancy in solitary nodules is 18%.

Solitary nodule of thyroid	No. of cases
Benign	41
Malignant	9
Total	**50**

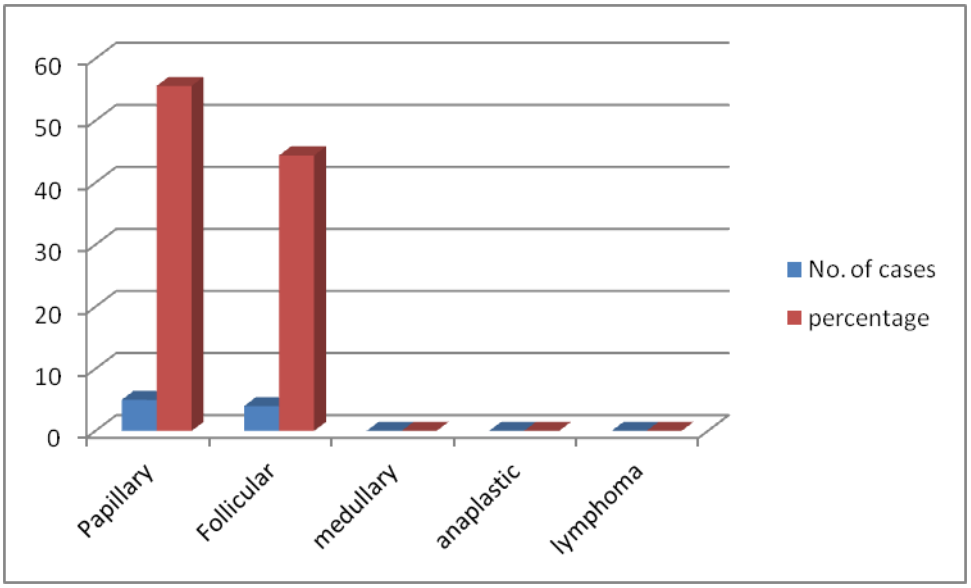


Type of carcinoma:

From the study, out of 9 carcinoma, 5 were papillary and 4 follicular: no case of medullary or anaplastic or lymphoma was detected. Papillary carcinoma accounts to 55.6% and follicular carcinoma accounts to 44.4%.

Type of carcinoma	No. of cases	percentage
Papillary	5	55.6
Follicular	4	44.4
Medullary	0	0
Anaplastic	0	0
Lymphoma	0	0
Total	**9**	**100**

TYPE OF MALIGNANCY :



SURGERY / OPERATIVE PROCEDURE DONE

Depending upon the clinical diagnosis and FNAC features, all 45 out of the 50 patients underwent surgery. Among them, patients 22 had undergone hemithyroidectomy, 14 cases undergone sub-total thyroidectomy and 9 cases undergone total thyroidectomy.

In 3 cases, HPE after hemithyroidectomy showed follicular carcinoma, then completion of total thyroidectomy done

Post-operatively, suppressive dose of thyroxine was started for patients who had undergone total thyroidectomy. Three cases out of 7 cases of total thyroidectomy showed features of hypocalcemia on 2-4 post-operative day, hence, they are supplemented with oral calcium and vitamin D3.

All the cases were followed up for 6months, two cases had husky voice without any change in vocal cord movements.

CLINICAL PICTURES OF SOLITARY NODULE OF THYROID

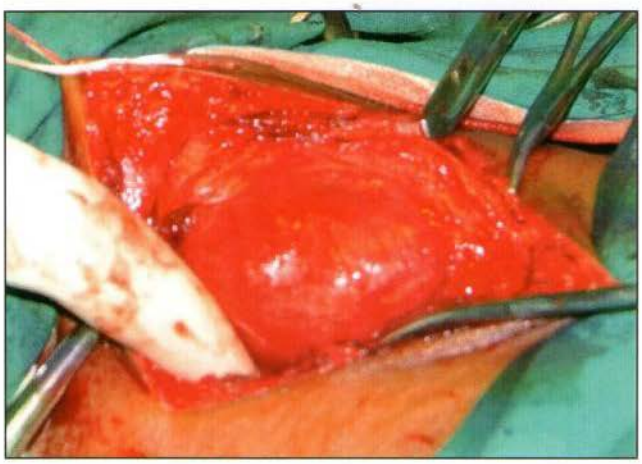


Figure – 29 : Lobe with SNT delivered after ligating the middle thyroid vein.

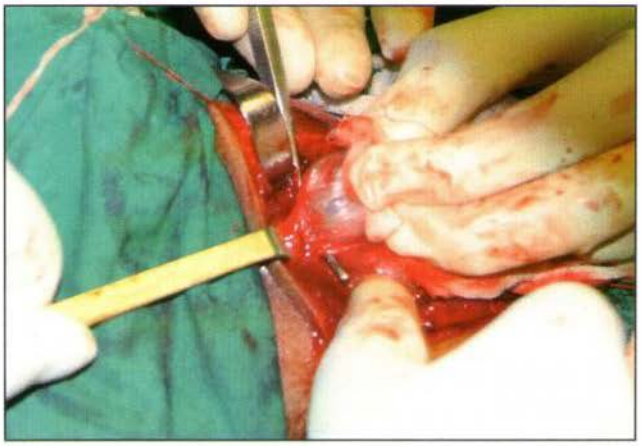


Figure – 30 : Superior pole being isolated.

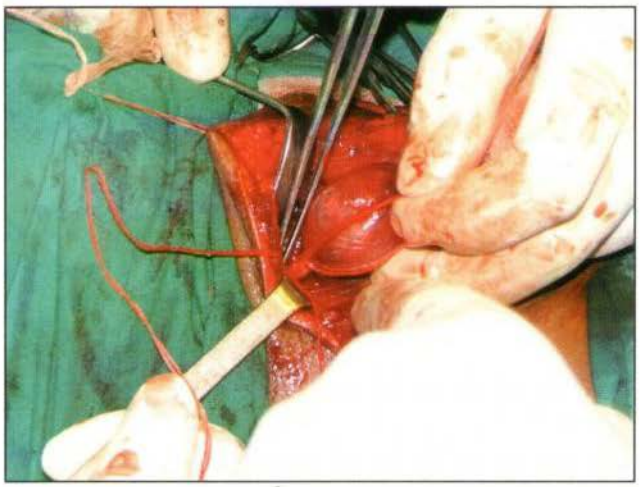


Figure – 31 : Superior pole ligated

DISCUSSION

The observations and results of the present study were compared with the available previous similar studies.

MEAN AGE AT PRESENTATION

AUTHORS	**MEAN AGE IN YEARS**
Das DK (1999)	35
Talepoor M(2005)	38.6
Quari F. (2005)	36.7
REHMAN A.U.(2009)*	34.7
Khurshid Anwar(2012)*	37
Present study	37.26

In the study done by Quari F and Talepoor M separately in 2005, reported the mean age at presentation as 36.7years and 38.6years respectively. Khurshid Anwar reported, in 2012, the mean age of presentation as 37years. From the present study, the mean age at presentation found to be 37.27years, correlates with the previous studies.

Most of the earlier series reported peak incidence of solitary nodule thyroid in the 3rd and 4th decades. Bhansali S.K[5] (1982), in his similar study, reported the peak incidence in 4th and 5th decade. In the present study, the peak incidence found to be 3rd to 5th decades, which constitutes about 60% of the cases studied.

SEX DISTRIBUTION

AUTHORS	**SEX INCIDENCE(M:F)**
Dorairajan (1996)	1:9
Das DK(1999)	1:5.39
Gupta C(2001)	1:5
Present study	**1:5.25**

In the study done by Dorairajan (1996) and Das DK (1999) reported ratio of sex incidence as 1:9 and 1:5.39 respectively. In the present study, its found to be 1:5.25, which correlates with Das DK STUDY (1999).

Because of periods of fluctuations in the demands of the hormonal requirement in female in their life cycle (puberty, menstrual cycles, pregnancy, menopause), the chances of thyroid nodule formation are very high as compared with male counterparts.

DISTRIBUTION OF NON-NEOPLASTIC AND NEOPLASTIC LESIONS DIAGNOSED BY FNAC

AUTHORS	NON-NEOPLASTIC	NEOPLASTIC	RATIO
Sarda AK (1997)	487	59	8.25:1
Das DK (1999)	346	85	4.07:1
Gupta C (2001)	470	30	15.66
Karur (2002)	32	15	2.13:1
Talepoor M (2005)	325	70	4.33:1
Hurtado Lopez M (2005)	80	50	1.6:1
Nagada (2006)	51	18	2.83:1
Chao CT(2007)	276	264	1.04:1
Present study	31	19	1.63:1

In the present study, neoplastic conditions include adenomas and all malignant lesions. From the study, the ratio of non-neoplastic to neoplastic cases is about 1.63:1, which is comparable to the studies done earlier like Hurtado Lopez M(2005), Chao CT(2007) & Karur (2002)

DISTRIBUTION OF MALIGNANCIES BY FNAC

AUTHORS	**PERCENTAGE**
Sarda Ak et al(1997)	10.8
Karur K et al(2002)	18
Mundsad B et al(2006)	4.16
Present study	10

In the present study, among 5 cases of papillary carcinoma, 4 were diagnosed with certainty by FNAC and the rest one was suspicious of malignancy. But 4 cases of Follicular carcinoma were initially reported as Follicular neoplasm. From the study, distribution of malignancy is about 10 percentage, which is comparable with the earlier study Sarda Ak et al.

Aetiological incidence (in percentage):

Series	MNG	Adenoma	Carcinoma	Others	Total No. of cases
Zaman & Bhagbati (1971)	83	9	8	-	2221
Ananth Krishnan (1983)	12	47	2	2	104
Bhansali (1982)	71	20	9	-	449
Fenn (1980)	22	55	12	11	342
Kapur (1982)	28	50	11	11	221
Present series	13	13	9	**15**	**50**

From the present study, common causes of solitary nodule is dominant nodule of multinodular goiter and follicular adenoma which is comparable with above studies.

INCIDENCE OF CARCINOMA:

STUDY	**YEAR**	**PERCENTAGE**
A S Fenn et al	1980	12.0%
Bhansali S K	1982	9.0%
Kapur et al	1982	11.0%
Wagana et al	2002	16%
Rehman A U	2009	11.47%
Present study	**2015**	**18%**

From the literature, the incidence of malignancy in thyroid nodule ranges from 5% to 30%. From the present study, the incidence found to be 18%, which is comparable with the study done by Wagana et al 2002.

CONCLUSIONS

The present study is a descriptive study of 50 cases of solitary nodule of thyroid, admitted to Govt. Royapettah Hospital, Chennai, during the period of November 2014 to September 2015 has been made. Though a large number of patients are required to come to better conclusions, based on the data and results obtained in the present study, the following conclusions can be drawn:

- Solitary nodule of thyroid is more common in females.
- Solitary nodule of thyroid is more common the age group of 20-50years.
- Most of the patients with solitary nodule of thyroid present with swelling alone.
- Most of the patients with solitary nodule of thyroid are in euthyroid state and only few present with toxicity and hypothyroidism.
- Incidence of malignancy in male patients presenting with solitary nodule thyroid is more when compared to female patients presenting with the same.
- commonest cause of solitary nodule of thyroid is dominant nodule of multi-nodular goitre.
- USG can be used to detect multi-nodular goitre in patients presenting with solitary nodule thyroid.
- FNAC is the investigation of choice in the evaluation of solitary nodule of thyroid. It has few pitfalls.

In such situations, only histopathology can confirm the exact pathology. It detects papillary carcinoma in a solitary nodule with high sensitivity and specificity.

- Papillary carcinoma is the most common malignancy of thyroid, followed by follicular carcinoma.

SUMMARY

A descriptive analysis of 50 cases of solitary nodule of thyroid, admitted to Govt. Royapettah Hospital, Chennai, during the period of November 2014 to September 2015 has been made and summarized below:

- Commonest presentation of solitary nodule is swelling in front of neck.
- The peak age at presentation of solitary nodule thyroid is 3rd to 5th decade, constituting about 60% of the cases.
- Solitary nodule is more common in females with the ratio M:F = 1:5.25.
- Most of the solitary nodule of thyroid are benign (89%).
- Most of patients with solitary nodule of thyroid are in euthyroid state (95%).
- After evaluation of solitary nodule thyroid, 26% of all the clinically solitary nodule turned out to be multi-nodular goitre.
- Common causes of solitary nodule thyroid are MNG (26%), follicular adenoma (24%) and adenomatous goiter (24%).
- Incidence of malignancy of solitary nodule is about 18%. Male to female ratio in case of malignant nodule is 1:5.
- Incidence of carcinoma in males presenting as thyroid nodule is higher (16.67%) compared to that of females (10.20%).
-

- The most common malignancy in solitary nodule thyroid is papillary carcinoma(55%), followed by follicular carcinoma(45%)

- FNAC is an important investigation in the evaluation of the solitary nodule of thyroid.

- Surgery has been the treatment of choice in most of the cases, either because of cosmetic reasons or toxicity or FNAC diagnosis of follicular neoplasm ormalignancy.

Transient hypocalcemia is common after total thyroidectomy for malignancies.

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ANNEXURE-1

PROFORMA FOR CLINICAL STUDY OF SOLITARY NODULE OF THYROID

Case No:

Name: Hospital:

Age: Unit:

Sex: D.O.A:

Occupation: D.O.D:

Address:

Contact No:

A. **Clinical diagnosis**:

B. Chief complaint and its duration:

a. Swelling

b. Pain

c. Others

C. History of presenting illness:

a. Swelling

i. Duration

ii. Site

iii. Mode of onset

iv. Progress of the swelling

v. Presence of other swelling(s)

vi. Secondary changes

b. Pain

i. Duration

ii. Onset

iii. site

iv. Nature

v. Radiation

vi. Aggravating factors

vii. Relieving factors

c. Pressure symptoms

i. Dysphagia

ii. Dyspnea

iii. Hoarseness of voice

iv. Voice fatigue

d. Symptoms suggestive of BMR changes

i. Appetite: increased/decreased/good

ii. Weight: increased/decreased/no significant change

iii. Sweating: increased/decreased/no significant change

iv. Any preference to hot or cold environment

e. Toxic symptoms

i. Primary toxicity

1. Irritability
2. Insomnia
3. Anxiety
4. Fear
5. Tremors of hands
6. Prominence of eyes
7. Diarrhea
8. Swelling of lower limbs- pretibial myxoedema

ii. Secondary toxicity

1. Palpitation
2. Precordial pain
3. Dyspnea on exertion
4. Swelling of lower limbs

f. Hypothyroid symptoms

i. Dullness

ii. Lethargy

iii. Loss of hairs

iv. Behavior-hypoactivity

v. Response to surroundings

g. Menstrual history-

menorrhagia/oligimenorrhoea/amenorrhoea

i. Flow

ii. Days

iii. Frequency

h. Symptoms suggestive of malignancy

i. Rapid increase in size

ii. Presence of other swelling(s) in neck – lymph nodes

iii. Recent onset of pressure symptoms/change in voice

iv. Chest symptoms- cough/breathlessness/hemoptysis

v. Loss of weight and loss of appetite

D. Past history:

i. h/o any drug intake

ii. h/o irradiation to neck in childhood

iii. h/o diabetes/hypertension/tuberculosis/asthma/allergy

E. Family history

i. h/o similar complaints in family members

ii. h/o similar complaints in locality

F. Personal history

i. Diet:

ii. Appetite:

iii. Sleep

iv. Bowel and bladder habits:

v. Habits:

GENERAL PHYSICAL EXAMINATION

Appearance: Pallor:

Look: Anxious/dull/normal Icterus:

Built: thin/moderate/obese Cyanosis:

Skin: Clubbing:

Hands: warm/moist/cold

Lymphadenopathy: Nutrition:

Tremors:

Vitals:

LOCAL EXAMINATION

1. Inspection

Swelling(s) - number:

-shape:

-size:

-borders:

-extent:

-surface:

-skin over the swelling:

-secondary changes:

fungation/ulceration/inflammation

-pulsation:

-engorged veins:

-trachea:

-any other swelling(s)-lymph nodes

2. Palpation:

-Local rise of temperature:

-Tenderness:

-Number:

-Shape:

-Size:

-Site:

-Extent:

-Borders

-Surface:

-Consistency:

-Mobility -skin

-on contraction of muscle

-anatomical plane

-Position of trachea:

-Carotids: normal/Displaced/Absent

-Bruit:

-Dilated veins:

-Regional lymph nodes:

3. Percussion:

-over sternum: Dull/Resonant

4. Auscultation:

-Tracheal position

-Bruit

5. Measurement of neck at the most prominent part:

SYSTEMIC EXAMINATION

Signs of toxicity -Primary

-Secondary

1. Cardiovascular system:

2. Respiratory system:

3. Central nervous system:

4. Per-abdominal examination:

CLINICAL DIAGNOSIS:

INVESTIGATIONS:

ROUTINE:

HB%:	Total Count:
Differential Count:	ESR:
Bleeding Time:	Clotting Time:
Urine Routine: Albumin-	ECG:

Sugar & microscopy-

Random Blood Sugar: Blood Urea:

Serum Creatinine: Chest-X-Ray:

HIV -1&2: HBsAg:

SPECIFIC INVESTIGATIONS:

-FNAC of nodule:

-Thyroid Profile:

-Indirect Laryngoscopy:

-Plain X-Ray Neck:

-USG Neck:

TREATMENT:

Pre-operative:

Surgical:-

Operative

Findings:

Post-

operative:

HISTO-PATHOLOGICAL EXAMINATION: -Macroscopic:

-Microscopic:

FOLLOW-UP:

CONSENT FORM

சுய ஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு :

"A CLINICAL STUDY ON SOLITARY NODULE OF THYROID "

ஆராய்ச்சி நிலையம் : பொது அறுவை சிகிச்சைத் துறை
கீழ்பாக்கம் மருத்துவக் கல்லூரி
சென்னை – 600 010.

பங்கு பெறுபவரின் பெயர் : வயது :

பங்கு பெறுபவரின் எண். :

பங்கு பெறுபவரது இதனை (✓) குறிக்கவும்

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களைப் பெறவும் வாய்ப்பளிக்கப்பட்டது. ☐

நான் இவ்வாய்வின் தன்னிச்சையாகத்தான் பங்கேற்கிறேன். எந்தக் காரணத்தினாலோ எந்தக் கட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக் கொள்ளலாம் என்று அறிந்து கொண்டேன். ☐

இந்த ஆய்வு சம்மந்தமாகவோ, இதைச் சார்ந்த மேலும் ஆய்வு மேற்கொள்ளும்போது இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளைப் பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன். ☐

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும், பரிசோதனை முடிவுகளையும் மற்றும் சிகிச்சை தொடர்பான முடிவுகளையும் மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்திக் கொள்ளவும் அதைப் பிரசுரிக்கவும் என் முழு மனதுடன் சம்மதிக்கிறேன். ☐

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். எனக்குக் கூறப்பட்ட அறிவுரைகளின்படி நடந்து கொள்வதுடன், இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ அல்லது எதிர்பாராத நோய்க்குறி தென்பட்டாலோ உடனே அதை மருத்துவ அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்கிறேன். ☐

பங்கேற்பவரின் கையொப்பம் .....இடம் ..... தேதி
கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....

ஆய்வாளரின் கையொப்பம் ..... இடம் ..... தேதி

ஆய்வாளரின் பெயர் .....

MASTER CHART

S.No.	I.P. No.	Name	Age	Sex	Dur. Symp	pressure symptom	toxic symp.	site	size(in cm)	consistency	lymph node(s)	Thyroid profile	USG	FNAC	surgery	HPE	Post op
1	25031	Jeya	40	F	6mon	-		L	4×3	Firm	-	-	SN	FN	HT	FA	
2	24067	Nirmala	45	F	2y	Discomfort		R	6×3	Firm	-	Hypo	MN	CN	STT	MNG	
3	27117	Kalyani	41	F	1y	-		R	5×3	Cystic	-	-	SC	CC	HT	SCT	
4	4052	Geetha	18	F	6 mon	-		L	3×4	Hard	-	-	PN	PC	TT	PC	
5	2926	Lakshmi	52	F	6 mon	-		R	5×4	Firm	-	-	MN	CN	STT	MNG	
6	3385	Ramesh	38	M	4 mon	-		R	4×2	Firm	-	-	SN	FN	STT→TT	FCT	
7	4693	Chandra	50	F	3 mon	-		L	5×4	firm	-	-	MN	CN	STT	CN	
8	7180	Pankaja	45	F	2 y	-		R	5×6	Cystic	-	-	SC	TC	NA	NA	
9	7557	Raja	24	M	8 mon	-		L	4×3	Firm	-	-	SN	FN	HT	FA	
10	7575	Murugama	38	F	1.5 y	-		L	4×4	Firm	-	-	MN	FN	NTT	FA	
11	8131	Manu	28	M	3 mon	-		L	5×6	Firm	-	-	SN	CG	HT	NCG	
12	8779	Muthumari	38	F	1 mon	Discomfort		R	8×4	Firm	-	-	MN	CN	TT	MNG	
13	8898	Usha	29	F	5 mon	-	hyper	L		firm	-	-	SN	FN	HT	FA	
14	9445	Rabiya	41	F	2 y	-		R	6×4	Firm	-	-	SN	LTy	NA	NA	
15	10882	Subha	28	F	4 mon	-		L	4×3	Firm	-	-	SN	CN	HT	CN	
16	11519	Savitha	25	F	1 y	-		R	3×3	Firm	-	-	SN	FN	HT	AT	
17	11543	Jeevarathy	36	F	2 y	-		R	5×4	Firm	-	-	SN	CG	HT-> TT	FCA	

18	12964	kala	25	F	1 y	-		L	4×3	Firm	-	-	MN	CG	STT	MNG	
19	13131	vijaya	59	F	4 mon	-		R	3×4	Firm	-	-	MN	NCG	STT	MNG	
20	14060	Lakshmi	30	F	1 y	-		L	5×6	Firm	-	-	SN	CG	HT	NCH	
21	14286	Mahadevam	51	F	2 y	-		L	5×5	Firm	-	-	SN	NCG	HT	NCG	
22	15511	Lalitha	23	F	8 y	-		R	4×5	Firm	-	-	MN	CG	STT	MNG	
23	16150	Balaki	58	M	3 mon	-		L	2×2	Firm	-	-	MN	NCG	STT	MNG	
24	16214	Parvathy	38	F	1 mon	pain		L	5×3	Firm	-	-	SN	LTy	NA	NA	
25	19844	rekha	22	F	1 y	-		R	4×5	Firm	-	-	SN	FN	HT	FA	
26	22241	Mari	23	F	7 mon	-		R	4×5	Firm	-	-	MN	CG	STT	MNG	
27	22605	Selva mary	43	F	2 y	-		R	5×3	Firm	-	-	MN	NCG	STT	MNG	
28	22660	Renuka	50	F	2 y	-	+	L	3×3	Firm	-	Hyp	SN	FN	HT	FA	
29	23284	Govindamal	30	F	6 mon	-		R	4×5	Firm	-	-	MNG	CG	STT	MNG	
30	23354	Venkatesh	38	M	3 mon	-		R	3×4	Firm	-	-	MN	NCG	STT	MNG	
31	27684	Manjula	24	F	4 y	Dysphagia	no	R	8×4	Firm	-	-	SN	FN	HT	FA	
32	28960	Savithri	66	F	2y	pain	no	R	3*2	Firm	-	-	SN	FN	HT	FA	
33	29193	pavithra	45	F	1 y	-		L	4×4	Firm	-	-	SN	FN	HT	FA	
34	29597	pooja	65	F	4 y	-	no	L	5×5	Hard	-	-	SN©	PC	TT	PC	
35	1964	Saraswathi	21	F	1 mon	-		L	2×3	Firm	-	-	SN	Susp	TT	PC	
36	3267	jannath	40	F	2 mon	-		R	3×3	Firm	-	-	SN	FN	HT→TT	FC	
37	6489	Karpagam	55	F	10 mon			R	5×4	Firm	-	-	SN	Goitr	HT	FA	
38	6722	Sita	31	F	5 mon	-		L	3×3	Firm	-	-	SN	FN	HT	FA	
39	6740	Jayasheela	19	F	4 y	mild discomf		L	6×6	Firm	-	-	MN	NCG	STT	MNG	

40	11169	babu	29	m	6 mon	-		R	4×5	Firm	-	-	MN	CG	NTT	FA	
41	12339	Savitha	26	F	1 y	-		L	4×3	Firm	-	-	MN	CG	STT	MNG	
42	13435	Asha	25	F	15 days	-		L	4×5	Firm	-	-	SN	CG	HT	NCG	
43	15666	Begum	42	F	5 mon	-		L	2×2	Firm	-	-	SN	LTy	NA	NA	
44	15707	Krishna	21	M	1 y	Pain		R	4×5	Firm	-	-	SN	CG	HT	FA	
45	16059	Rathnam	23	F	2 mon	-		R	2×3	Firm	-	-	SN	PC	TT	PC	
46	16063	Yashoda	35	F	3 y	-		R	6×5	Firm	-	-	SN	HFL	HT	FA	
47	16379	Sushila	52	F	2 y	-		L	4×3	Firm	-	-	SN	FN	TT	FC	
48	17497	vijaya	45	F	4 mon	-		L	3×4	Firm	-	-	SN	FN	HT	FA	
49	18177	Manju	50	F	1 y	-		R	2×2	Firm	-	-	MN	AG	STT	Hash	
50	18409	Prema	43	F	1.5 y	-		L	4×4	Cystic	-	-	SC	SCT	NA	NA	

KEY TO MASTER CHART

AG	Adenomatous goiter
B	Benign
CA	Carcinoma
CG	Colloid goiter
FA	Follicular adenoma
FC	Follicular carcinoma
FN	Follicular neoplasm
HT	Hemithyroidectomy
L	Left
MNG	Multi-nodular goiter
NCG	Nodular colloid goitre
NTT	Near total thyroidectomy
PC	Papillary carcinoma
R	Right
SC	Simple cyst of thyroid
SNT	Solitary nodule thyroid
STT	Sub total thyroidectomy
TT	Total thyroidectomy
NA	Not Applicable